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THESIS

**IMPROVING LIFE-CYCLE COST MANAGEMENT IN THE
U.S. ARMY: ANALYSIS OF THE U.S. ARMY AND
COMMERCIAL BUSINESSES LIFE-CYCLE COST
MANAGEMENT**

by

Bradley A. White

June 2001

Thesis Co-Advisors:

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CYCLE COST MANAGEMENT**

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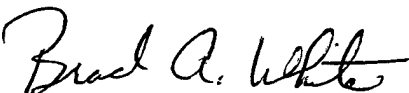
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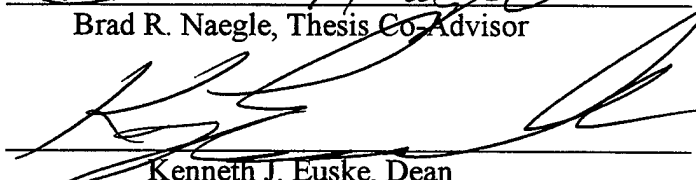
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ABSTRACT

The roles and responsibilities of the Army acquisition and logistics communities, as they pertain to the life-cycle management, are undergoing fundamental change. The early identification and total control of life-cycle cost, in particular operations and sustainment costs which comprises as much as 70-80% of a systems total life-cycle cost, is a high priority for the Army. The basis of this change is adoption of commercial best practices to support the Army's goal to organize, train, equip, and manage multiple missions in the most cost effective manner.

This thesis describes how the U.S. Army and four commercial businesses (FEDEX, Boeing Commercial Airplanes, Lockheed Martin, and a Communications Systems Company) manage life-cycle costs (LCC) for the equipment they use to manufacture products or to provide services. The research analyzes how the U.S. Army compares to these commercial businesses and how they are organized to perform the key functions of acquisition and sourcing, and operations and sustainment, to provide quality products or services to their customers while controlling total life-cycle costs of the capital equipment they use to provide their product or service. The thesis concludes with recommendations on how the U.S. Army can best organize and focus to better manage the total life-cycle costs of the equipment they purchase to complete their mission.

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I. INTRODUCTION

Logistics is now more than an \$80 billion dollar slice out of the Department of Defense annual budget. Simply reducing our logistics costs by 10 percent can save billions of dollars. However, the primary purpose of the modernization of DoD logistics is to greatly enhance the responsiveness and dependability of our support to the types of military operations we anticipate in the coming years. So, this is something we must do – and soon! I want to stress, first and foremost, that acquisition and logistics reform is not just a long-range strategy for the Department; It is an urgent need and it is going to come about only as the result of a lot of hard work by our acquisition and logistics teams and our partners in private industry. It must be our highest, and most urgent priority. (Hon. Jacques S. Gansler, Under Secretary of Defense Acquisition, Technology, and Logistics, October 18, 1999) [Ref. 1]

A. BACKGROUND

The roles and responsibilities of the Army acquisition and logistics communities pertaining to life-cycle cost management are undergoing fundamental change. To field a weapon system in today's environment is expensive. Prices are increasing and the acquisition process continues to be a source of rigorous Congressional scrutiny. There is a concerted effort underway by the DoD to stress the importance of life-cycle management and to reduce the portion related to sustainment burden and cost. Although there are differences in opinion among professionals over how great the ratio of operating and support (O&S) costs are in relation to total life-cycle costs, most agree that: (1) they are substantial, (2) many associated with current Army equipment could have been decreased, and (3) we suffer from decreased readiness in part due to our inability to control O&S costs for our existing equipment.

Since total obligation authority for the Army is expected to remain constant, it is critical that future procurements yield systems that are extremely reliable and

maintainable to ensure an affordable O&S “bill” later in the product’s life. Congress, the DoD, and the Army have introduced a host of initiatives to ensure this reliability.

In U.S. commercial manufacturing, business value has flowed steadily downstream, from producing goods to servicing them. Manufacturers that are thriving have gone beyond the factory gates and begun competing in downstream markets to tap into the valuable economic activity that occurs throughout the entire product life-cycle. Since 1960, service share of the U.S. gross domestic product has grown by 16 percentage points, to 40% of GDP, while manufacturing’s share has declined by ten percentage points, to just 17% of GDP. [Ref. 2] In many manufacturing sectors, revenues from downstream activities now represent ten to 30 times the annual dollar volume of the underlying product sales. In corporate computing, for example, the average company spends only about one-fifth of its annual personal computer budget on purchasing the boxes themselves; the rest goes to technical support, administration, and other maintenance activities. In the rail industry, the major railroads now spend \$28 billion a year maintaining and operating their locomotives and related infrastructure, but they purchase less than \$1.4 billion worth of new locomotives per year. The average household spends more than \$6,000 per year on auto-related expenses, but only about 20% goes to the purchase of a new car, the rest covers expenses such as gas, insurance, repairs, and financing [Ref. 2].

From a procurement and logistics perspective, these examples are just a few that illustrate the importance of controlling downstream O&S costs early in the acquisition process in order to ensure long term affordability. Spending more money upfront in the

acquisition process, thus making the products procured more reliable, could reduce these downstream costs significantly.

While commercial industries interest in controlling downstream O&S costs increased during the 70's and 80's, the Army was making large procurements such as the M1 Tank, the Bradley Fighting Vehicle, the Apache, the Multiple Launch Rocket System, the Avenger, and the Armored Combat Earthmover to name a few. Reports from that time period by the General Accounting Office (GAO) indicate that, in general, the DoD placed less emphasis on the total cost of ownership, even though such costs could ultimately amount to more than acquisition costs. In several cases, life-cycle cost control efforts were sacrificed to remain within budget or to provide performance enhancements.

The demise of the Soviet Union as our Nation's greatest threat caused funding reductions in the early 1990's. These funding reductions have forced the military services to defer modernization. This deferment resulted in an aging fleet that requires increased maintenance, which in turn, drives operating and support (O&S) costs up and readiness down. With the total obligation authority relatively constant, increased O&S costs squeeze procurement accounts, resulting in more deferred modernization—a vicious cycle. The requirement to maintain aging equipment costs much more each year with regard to repair costs, down time, and maintenance tempo. Nonetheless, we must keep this equipment in repair to maintain readiness. This practice drains our resources in a way that prevents us from modernizing, developing, and employing new systems. The result is that replacement schedules get stretched to unacceptable lengths, which reduce the quantities of the new equipment we purchase and raises their costs—further delaying modernization.

B. AREA OF RESEARCH/SCOPE

The roles and responsibilities of the Army acquisition and logistics communities as they pertain to the life-cycle management are undergoing fundamental change. The basis of this change is adoption of commercial best practices to support the Army's goal to organize, train, equip, and manage multiple missions in the most cost effective manner.

This thesis describes how the U.S. Army and four commercial businesses (FEDEX, Boeing Commercial Airplanes, Lockheed Martin, and a Communications Systems Company) manage life-cycle costs (LCC) for the equipment they use to manufacture products or to provide services (e.g. trucks at FEDEX, test equipment at Lockheed Martin, or robots at Boeing).

This research also analyzes how the U.S. Army and these commercial businesses studied are organized around the key functions, acquisition and sourcing and operations and sustainment, in order to provide quality products or services to their customers, while controlling total life-cycle costs of the capital equipment they use to provide their product or service. The thesis concludes with recommendations on how the U.S Army can best organize and focus to better manage the total life-cycle cost of the equipment they purchase to complete their mission.

C. RESEARCH QUESTIONS

This research will address and answer the following questions:

1. Primary Research Question

How are four leading-edge commercial businesses organized to manage life-cycle costs for the equipment they use to manufacture products or to provide services? What can the Army learn from these businesses to improve its life-cycle cost management?

2. Secondary Research Questions

- How is the Army organized to control life-cycle costs?
- How do these commercial businesses manage life-cycle costs for their products and the products they use to provide products and services?
- As the Army seeks to improve its life-cycle cost management, what changes are under consideration and how do they reflect commercial best practices?

D. METHODOLOGY

The methodology used in this thesis research can be divided into four primary steps:

- A literature search of books, magazine articles, and other library information resources focusing on ways to control life-cycle costs.
- A thorough review the Army's acquisition procedures and management of life-cycle O&S costs through literature review, personal and telephonic interviews with the office of Assistant Secretary of the Army for Acquisition, Logistics and Technology, the Office of the Deputy Chief of Staff for Logistics, and the Army Materiel Command.
- Construction of case studies of four commercial corporations through surveys and phone interviews. These corporations included FEDEX (service provider), Lockheed Martin (product provider), a Communications Company (product provider), and Boeing (product provider).
- An analysis of Army and commercial businesses organizational structures as they pertain to the life-cycle management of the products they produce or the service they provide as well as the capital equipment they use to provide their product or service.

E. LIMITATIONS

Although I solicited over 20 companies for inclusion in this study, only the four companies, three manufacturing companies and one service provider, that I discuss in this thesis were willing to provide the depth of information needed for meaningful analysis and comparison.

F. ASSUMPTIONS

Throughout this thesis, I assumed that the reader is familiar with the Federal Acquisition process, has a general understanding of life-cycle cost, and is familiar with basic Army and DoD terminology as well as basic acquisition and logistics terminology.

G. DEFINITIONS

For the purpose of this thesis, the term life-cycle cost (LCC) will be used synonymously with ownership costs, total ownership cost (TOC), and, unless otherwise specified, “cost” will refer to LCC vice unit-production cost. From a program management perspective, TOC is the same as LCC which DoD officially defined in November of 1998 as:

The sum of all financial resources necessary to organize, equip, train, sustain, and operate military forces sufficient to meet national goals in compliance with all laws, all policies applicable to DoD, all standards in effect for readiness, safety, and quality of life, and all other official measures of performance for DoD and its components. DoD TOC is comprised of costs to research, develop, acquire, own, operate, and dispose of weapon and support systems, other equipment and real property; the costs to recruit, train, retain, separate and otherwise support military and civilian personnel; and all other costs of business operations of the DoD. [Ref. 3]

H. ORGANIZATION

This thesis is divided into five chapters. Chapter I presents the problem, background, stated the area of research, and described the methodology, and associated research questions. Chapter II identifies how the U.S. Army is organized to control life-cycle costs. Chapter III identifies four commercial businesses, their mission, and how they manage life-cycle costs for their products, services, and capital equipment. Chapter IV analyzes how the U.S. Army and the four commercial businesses studied are organized around the key functions, acquisition and sourcing and operations and

sustainment, in order to provide quality products or services to their customers, while controlling total life-cycle costs of the capital equipment they purchase to provide their product or service. Chapter V recommends what the Army should do to improve its life-cycle cost management.

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II. ARMY LIFE-CYCLE MANAGEMENT

On December 4, 1995, Dr. Paul Kaminski, Under Secretary of Defense for Acquisition and Technology wrote, "Reducing the cost to acquire and operate the Department's (DoD) equipment while maintaining a high level of performance for the user is my highest priority" [Ref. 4].

This chapter outlines how the Army has shifted focus from acquisition cost management to life-cycle cost management for the systems we buy. I will identify the key players, to include the Army Acquisition Executive (AAE), the Program Manager (PM), the Army Materiel Command (AMC), and the Army Training and Doctrine Command (TRADOC), in life-cycle management in both the acquisition and sustainment phases of equipment, their roles, the changes to acquisition policy and, strategy and initiatives implemented to more effectively manage life-cycle costs. Figure 1 below outlines the Army's organizational structure as it pertains to Army acquisition.

A. ARMY ACQUISITION EXECUTIVE (AAE) – ASSISTANT SECRETARY OF THE ARMY FOR ACQUISITION, LOGISTICS, AND TECHNOLOGY ((ASA (ALT))

The Assistant Secretary of the Army (Acquisition, Logistics, and Technology) (ASA (ALT)) serves, when delegated, as the Army Acquisition Executive, the Senior Procurement Executive, the Science Advisor to the Secretary, and serves as the senior research and development official for the Department of the Army. The ASA (ALT) also has the principal responsibility for all Department of the Army matters related to logistics. Among the responsibilities of the ASA (ALT) that contribute to managing life-cycle costs are the assignment, management, and evaluation of PEOs and PMs; the

execution of the acquisition, logistics, procurement, contracting, research, development, and testing functions; and the execution of the Army's acquisition management system.

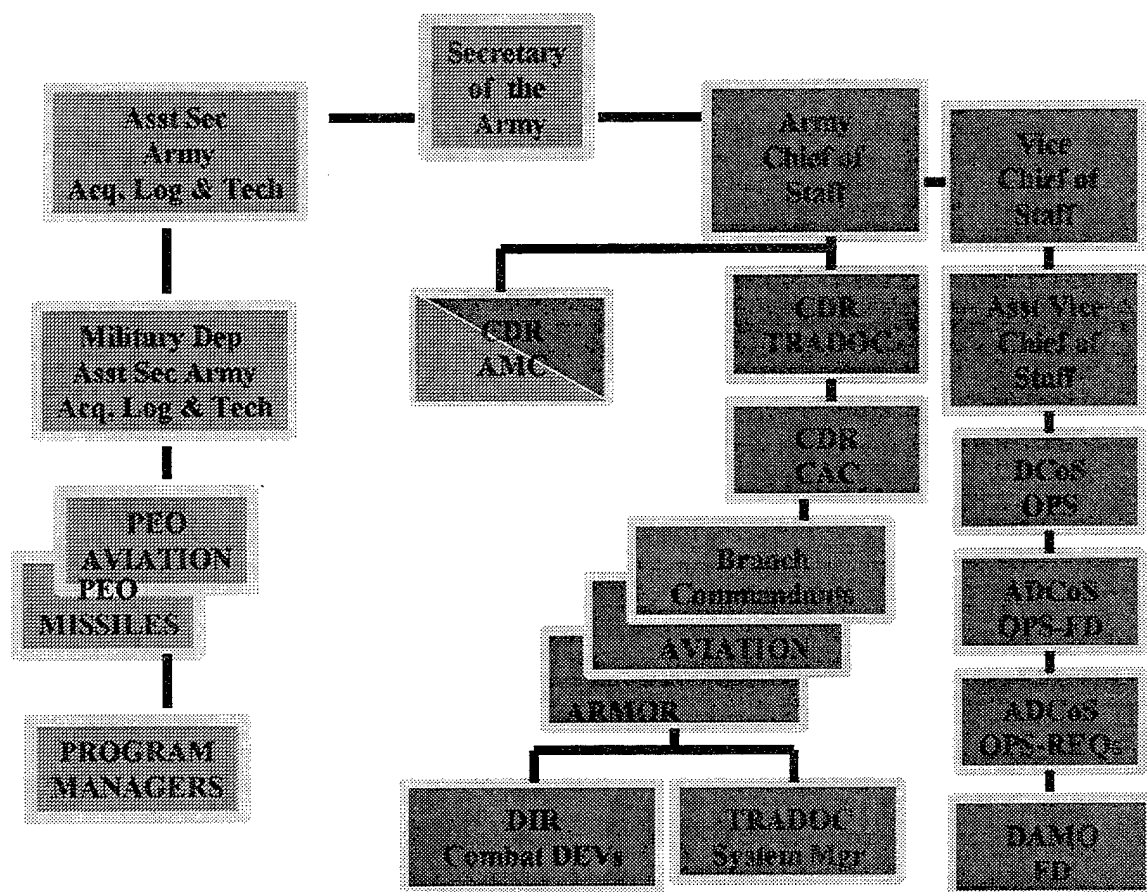


Figure 1. U.S. Army Acquisition Organizational Structure

Life-cycle Management within DoD came to the forefront in 1995 when Dr. Kaminski announced life-cycle cost as his highest priority. With this new focus, the Army has instituted changes to policy and organization, and instituted new strategies and initiatives to shift acquisition and sustainment focus on life-cycle management.

1. Assigning Responsibility of Life-Cycle Cost Management

The first attempt to shift focus was a policy memorandum signed by Gilbert F. Decker, the then Assistant Secretary of the Army for Research, Development, and Acquisition, 29 April 1997. This memorandum addressed the shift from acquisition cost to life-cycle cost management and assigned responsibility of life-cycle cost management to the PEOs and Major Commands who manage Acquisition Category (ACAT) systems. He wrote,

Effective immediately, Program Executive Officers (PEOs) and Major Commands (MACOMs) who manage ACAT systems are responsible for the management of total life-cycle costs for these systems. The PEOs and MACOMs will take actions to minimize estimated sustainment costs of developmental systems and reduce sustainment costs of deployed ACAT systems they manage. [Ref. 5]

This memorandum was further clarified and reinforced a year later in a memorandum to the acquisition community, signed by the acting Assistant Secretary of the Army for Research Development and Acquisition, Kenneth Oscar, effectively placing Program Managers (those assigned to PEOs and AMC or other MACOMs) in charge of life-cycle cost management. The memorandum stated,

The goal of our campaign is unchanged -- to place the Program Managers (PMs) in charge of the total life-cycle for assigned systems. This includes responsibility and authority for planning, programming, budgeting, and executing sustainment funds associated with their systems. The Under Secretary of Defense (Acquisition & Technology) actively supports charging the PMs with sustainment responsibilities and authorities. It will take time to completely realize this change. Many organizations and procedures are affected and concurrence to move sustainment-funding responsibility to the PMs will not be automatic. The senior acquisition leadership will continue to work with logistics and financial proponents to reform current processes and to put in place the structures and mechanisms necessary for PMs to perform expanded sustainment functions. [Ref. 6]

2. Establishment of Pilot Programs in Total Life-Cycle Cost Management

In 1998, DoD directed each of the services to designate at least 10 significant programs for which the PM will be made responsible for ensuring that the product support functions are properly carried out over its entire life-cycle. This program was established to give the PM incentive to take action during development or modification of their systems to design in features that will improve reliability, availability, and maintainability of the fielded system. Responsibility for operation and support costs is important to provide incentive for proper trade-offs during development, acquisition, and modification, and to control total ownership cost. Funding control improves program stability and allows PMs to optimize the effectiveness of, and support for, their weapon system. In September 2000, GAO published a report that examined the Army's 10 pilot programs. This report addressed the effectiveness of the Army's efforts to reduce the operating and support costs for: (1) weapons systems under development, and (2) fielded weapon systems. GAO found that the Army is unlikely to significantly reduce projected operating and support costs of weapons systems under development in part because it had not established needed mechanisms to achieve the reductions. Furthermore, the Army's cost reduction efforts for fielded systems lacked the priority needed to meet DOD's goals.

[Ref. 7]

GAO's report made the following recommendation to help maintain DoD's goals:

- Establish operating and support cost requirements for developmental and fielded systems and regularly monitor each system's progress in meeting the requirement;
- Develop a more complete and accurate accounting of each weapon system's operating and support costs by expanding the Army's current cost data system to include additional cost elements such as software and supply system support costs;

- Promptly provide the necessary funding and staffing to fully establish the Total Ownership Cost Directorate. [Ref. 7]

3. Merger of Acquisition and Logistics – ASA (RDA) – ASA (ALT)

In 1999, the Army merged Acquisition and Logistics to form the Assistant Secretary of the Army for Acquisition, Logistics, and Technology. The reason for this merger was to improve the Acquisition process by putting life-cycle weapons policy and management in one place, establishing an integrated focus on total life-cycle cost, and allowing decision-making for life-cycle cost at the lowest possible level. This merger established a Deputy Assistant Secretary of the Army for Logistics who reports to the ASA (ALT) for total logistics mission. The purpose of this merger is to integrate Acquisition and Logistics Policy/Planning, bring together the Acquisition and Logistics Reform groups, and improve life-cycle management while maintaining critical logistics focus. One of the most significant actions established by the ASA (ALT) was to develop a Modernization Success Spiral Strategy based on Life-Cycle vs. Operational Considerations rather than the previous strategy, which was to buy based on Acquisition Cost vs. Operational Considerations. [Ref 8]

4. Establishment of Total Ownership Cost Working IPT

In March 1999, ASA (ALT) established the Total Ownership Cost Working Integrated Product Team and Senior Steering Group whose purpose is to Establish Army management structure to provide leadership, guidance and implementation of Army TOC initiatives and address long term solutions for optimizing allocation of Army resources. The mission and scope of this TOC Organization is:

- To act as the Army central integration point for management of TOC initiatives;

- To identify required policy and process changes needed to widely utilize TOC initiatives;
- To fully integrate TOC initiatives within the planning, programming and budget process;
- To foster cooperative TOC ventures across Army organizations;
- To serve as an Army central advocate for TOC initiatives regardless of the magnitude of the project. This will include initiatives from Army, other services and industry;
- To widely disseminate TOC initiative information throughout the Army, and to other Services;
- To fully inform senior leadership of current and planned actions within the TOC community. [Ref. 9]

5. Assigning Responsibility of Life-Cycle Cost Management to PMs/AMC

In March of 2000, the ASA (ALT) issued a memorandum rescinding the two previous memorandums issued by Decker [Ref. 5] and Oscar [Ref. 6] which focused on how the Army would tackle life-cycle management. This change put the onus of life-cycle management on the Program Manager with support from AMC/DCSLOG. The memorandum stated that,

The focus of life-cycle management is to develop, field and sustain high quality warfighting systems at the lowest total cost. Life-cycle support is a shared responsibility between AMC/MACOMs (and their subordinate commands) and the PMs they support. We must vigorously apply DoD Directive 5000.1 because of the importance of sustainment on the battlefield (i.e., lighter forces and smaller footprint). This approach places emphasis on addressing sustainment issues early in the system life-cycle to: (1) reduce long-term costs; (2) adhere to integrated and streamlined total Army business processes; (3) facilitate meeting the Army's modernization objectives; and (4) address readiness, operational and training issues. [Ref. 10]

As indicated in this memorandum, life-cycle management is a joint venture with the Program Manager and AMC/MACOMs working hand in hand.

B. PROJECT/PROGRAM/PRODUCT MANAGERS

The program management approach to materiel acquisition management is a distinct departure from the Services' traditional practice of establishing functionally oriented organizations to carry out well defined, repetitive, and continuous long-term tasks. Organization for program management is a tailored, task-oriented process. This approach requires the program manager to establish management arrangements among the PM Office (PMO), other military organizations, and various contractors to coordinate their efforts and to accomplish program objectives effectively, efficiently, and economically.

A variety of PMO organizations have been established. They operate on the matrix management principle and must draw all functional support from a host command or installation. In addition to the formal PM organization, the PM directs the informal Materiel Developer (MATDEV)/Combat Developer (CBTDEV) team to execute the assigned materiel acquisition program. The MATDEV/CBTDEV team is the terminology used to describe the informal, but essential close working relationship among the MATDEV, CBTDEV, and other players in the RDA management process.

The PM has authority and responsibility for all programmatic cost, schedule, and performance decisions to execute the assigned program within the approved acquisition program baseline (APB) and is subject to functional standards established by regulation, Secretarial direction, or law. Generically, all PMs are program managers, but they are chartered as a Program Manager, a Project Manager, or Product Manager based on the value and importance of the program they manage. The criteria established for designation of a Program Manager are generally the same as those which cause a system

acquisition to be designated as a major program—high defense priority, high dollar value, or high Congressional or Office of Secretary of Defense (OSD) interest. Most Program Managers report to a PEO and to the AAE. Project and Product Managers report to a Program Manager or a PEO. The Army also has many PMs who report to the U.S. Army Materiel Command (AMC) and the U.S. Army Space and Missile Defense Command (SMDC). Their programs are usually more mature systems or programs that have been through production and fielding. As a general rule, a program manager is a general officer or Senior Executive Service (SES); a project manager is a colonel or GS-15; a product manager is a lieutenant colonel or GS-14. [Ref. 11]

PMs have the lead to ensure performance and minimize costs throughout the life-cycle. They must base their program decisions on readiness considerations, business processes, and the optimization of total life-cycle costs. Therefore, the PMs are responsible for ensuring that a viable Operations and Support Cost Reduction (OSCR) Program is developed to permit timely and effective changes to reduce overall costs throughout the life-cycle. By doing so, the PMs will facilitate the role of AMC/MACOMs to execute sustainment in the most cost effective manner with an optimal support strategy. In short, PMs are responsible for the life-cycle management of their systems, provided such actions do not jeopardize the AMC/MACOMs' Army-wide readiness and supportability responsibilities. [Ref. 10] In order to manage life-cycle costs, PMs use several strategies/initiatives. These strategies include Cost as an Independent Variable (CAIV), Systems Engineering Process (SEP), and Integrated Product and Process Development (IPPD).

1. Cost as an Independent Variable (CAIV)

Cost as an independent variable is a key acquisition strategy that defines cost-performance trade-offs. CAIV engages the combat developer, the developer, and the supporter in meaningful trade-offs to arrive at an affordable balance between performance, cost, and schedule. These trade-offs enable the combat developer to make choices that obtain the best performance within available resources.

CAIV involves setting aggressive, realistic cost objectives for acquisition systems and managing risks to obtain those objectives. The cost objectives should balance mission needs, considering available and projected resources and technology requirements. CAIV does not mean prioritizing cost, performance, and schedule equally but means choosing the best, most affordable cost objective, and sticking to it. CAIV objectives should be set as early as possible, preferably prior to Milestone I. Trade-off flexibility between procurement and operation and support (O&S) cost objectives should also be considered. While CAIV was originally developed from a systems acquisitions perspective, variants, or CAIV-related concepts, are currently being prototyped in Non-ACAT acquisitions, particularly for service contracts. Important to the implementation of CAIV are:

- Clearly defined cost objectives consistent with the requirements and projected fiscal resources;
- Key trade-off areas identified in the Statement of Work (SOW) and specifications;
- A minimum number of performance specifications (critical performance criteria), identifying trade-off flexibility in requirements and program baseline;
- Robust contractor incentives for achieving cost objectives during all program phases to motivate contractors to achieve program objectives;

- Appropriate metrics for tracking progress in setting and achieving cost objectives;
- Clear indications of how life-cycle cost objectives, (e.g., manning, maintenance and training), are to be measured. [Ref. 12].

2. Systems Engineering Process (SEP)

Another strategy PM's use is Systems Engineering Process. Systems engineering involves design and management of a total system, which includes hardware and software as well as other system life-cycle elements. The systems engineering process is a structured, disciplined, and documented technical effort through which systems products and processes are simultaneously defined and developed. Systems engineering is most effectively implemented as part of an overall integrated product and process development effort using multidisciplinary teamwork. Life-cycle costs can be directly traced to the System Engineering process as the system parameters are determined through SEP. Most life-cycle costs occur in the operations and support, but it is the design that locks in these costs early in SEP. Early SEP decisions set the course for life-cycle costs. This is why the SEP is critical in development of a system because it drives total life-cycle costs.

3. Integrated Product and Process Development (IPPD)

Another strategy used by the PM is Integrated Product and Process Development (IPPD). The PM applies the concept of IPPD throughout the acquisition process to optimize design, manufacturing, business, and supportability which all have direct impact on total life-cycle costs. IPPD is a management technique that integrates all acquisition activities, starting with requirements definition through production, fielding/development, and operational support. At the core of IPPD implementation are the Integrated Product

Teams (IPTs). Integrated Product Teams are cross-functional teams formed for the specific purpose of delivering a product to an external or internal customer. IPT members should have complementary skills and be committed to a common purpose, performance objectives, and methodology to which they hold themselves mutually accountable. IPTs are the means through which Product and Process Development (PPD) is implemented.

Members of an integrated product team represent technical, manufacturing, business, support functions and organizations or stakeholders critical to developing, procuring and supporting the product. Having all stakeholders represented concurrently permits teams to consider alternatives quickly and enables faster and better decisions. Once on a team, the role of an IPT member changes from that of a member of a particular functional organization focused on a given discipline to that of a team member focusing on a product and its associated processes. Each individual should offer his/her expertise to the team as well as understand and respect the expertise available from other team members. Team members work together to achieve the team's objectives.

IPTs are only successful if its members are empowered to contribute to the team's mission. This means that they have the authorization to work and make decisions without the constant supervision of their supervisors. The Honorable Paul G. Kaminski, Under Secretary of Defense, presented the following remarks as the keynote address for Acquisition and Technology (A&T) during a DOD Integrated Product Teams (IPT) Conference, July 20, 1995, at the Defense Systems Management College, Fort Belvoir, VA:

Integrated product teams are committed to program success. The teams are responsible for delivering a product--to field systems for the

warfighter. The objective will always be to provide the warfighter with more capability, sooner and at less cost. Integrated product teams include representatives from all the appropriate "oversight" functional disciplines working together with a team leader to ensure we build successful and balanced programs. The two most important characteristics of IPTs are empowerment and cooperation--trust n' teamwork by another name. The teams must have full and open discussions with no secrets. Team members must be empowered to speak for their superiors in the decision-making process. [Ref. 13]

PMs are required to establish O&S Cost Reduction IPTs to facilitate planning, execution, and measurement actions. IPT membership should represent all O&S process stakeholders. PMs should use the IPT as a tool to optimize overall program execution by eliminating "stovepipe" practices that optimize functional discipline, but sub-optimize the total system.

The PMs have enormous responsibility in life-cycle cost management. They must not only ensure life-cycle cost is priority in acquisition of the system, but they must also keep in mind that life-cycle cost is even more important in the sustainment phase of a system's life. To ensure they keep in mind sustainment of a system, PMs must work hand-in-hand with the Army Materiel Command who provides sustainment support for the Army's systems.

C. ARMY MATERIEL COMMAND (AMC)

The Army Materiel Command performs assigned materiel and related functions for research and development; developmental testing, acquisition and logistics support of materiel systems; and other materiel acquisition management functions required by the Department of the Army. AMC is the principal Materiel Developer in the Army.

The Army Materiel Command has a double impact on life-cycle cost management. AMC has integral PMs for certain programs, and it provides the sustainment support for the majority of the PEOs and other PMs in the Army.

In a 20 March 2000 policy memorandum signed by the AAE, the Honorable Mr. Hoeper, AMC was assigned the lead to minimize life-cycle costs through process control, optimize depot and arsenal workforces for efficiency and cost effectiveness, and manage broad-based logistics for the Army. Additionally, AMC must support the PMs throughout the acquisition process. [Ref. 10] AMC utilizes several life-cycle cost reduction programs to support the Army's focus on life-cycle cost reduction. I will address three such programs: Operation and Support Cost Reduction (OSCR), Modernization through Spares, and Prime Vendor Support.

1. Operation and Support Cost Reduction (OSCR)

OSCR's objective is to achieve cost reduction across the Procurement and RDT&E accounts on all Army acquisition programs. The aim of this guidance is to realize a 20% or better cost reduction to free up Total Obligation Authority for urgent modernization priorities while minimizing life-cycle costs.

Program, project, or product managers (PMs) are asked to develop a formal Cost Reduction Plan (CRP) which documents the commitment to achieve the needed savings for the Army. All members of the acquisition community are empowered to leverage ongoing acquisition reform efforts and any other initiatives aimed at realizing efficiencies in the way the Army develops, tests, and procures materiel. The Cost Reduction Plan should use Cost as an Independent Variable (CAIV) to establish life-cycle cost objectives for development, production, and operations and sustainment.

Army leadership has directed the Acquisition community to apply proven cost reduction techniques from certain ACAT I programs to all acquisition programs. At the individual program level, the objective is to maximize life-cycle savings and to improve the timeliness and efficiency of our developmental and procurement processes. While the obligation for cost reduction applies to both RDT&E and Procurement accounts, the ultimate aim is to reduce the total cost of ownership to the Army. Changes in these accounts should not adversely affect operation and support (O&S) cost. Therefore, CRP's must address total life-cycle cost impacts. [Ref. 14]

2. Modernization Through Spares (MTS)

Another strategy employed by AMC is Modernization Through Spares. Modernization Through Spares (MTS) is a spares/component improvement strategy applied throughout the Acquisition Life-cycle that is based on technology insertion to enhance systems and extend useful life while reducing costs. MTS is an initiative intended to reduce operation and support (O&S) costs. MTS is accomplished via the spares acquisition process. Spares acquisition spans a continuum from parts to components to subassemblies to assemblies for operational systems. Acquisition reform is a response to the changes in the defense environment of the 90's. MTS, a subset of acquisition reform, seeks to improve a system's spares. It is centered on performance-based requirements, in contrast to "Military Specification," detail design requirements. The emphasis is on form, fit, and function, allowing a supplier greater design and manufacturing flexibility to exploit technology used in the commercial marketplace. This approach ensures that system readiness is maintained and reduces life-cycle costs.

All Army managers who develop systems or buy spares are responsible for implementing MTS. Normally personnel responsible for spares acquisition are not responsible for system improvements. However, MTS requires an integrated approach among functional disciplines supporting spares acquisition. Hence, an Integrated Process Team (IPT) approach will be used to foster cultural change. [Ref. 15]

3. Prime Vendor Support (PVS)

The final program AMC has implemented to help reduce life-cycle cost is Prime Vendor Support (PVS). PVS is an initiative with industry that saves operations and support (O&S) costs by having the prime contractor assume responsibility for total performance of a weapon system and its modernization by integrating modernized spare parts. A current example of PVS is the Apache Helicopter PVS initiative. The Army received a joint proposal from Boeing-Lockheed Martin for implementing a PVS for the Apache helicopter in April 1997. The Boeing-Lockheed Martin concept, on which the Army has negotiated a tentative agreement, would transfer responsibility for complete wholesale support for the Apache to a single, accountable entity, a limited liability company known as Team Apache Systems (TAS). Essentially, TAS would eliminate the need for Government personnel and facilities to acquire, manage, store, and distribute spare parts and would interface directly with and provide repair parts to the soldier at the retail level.

The major advantages of such an arrangement would be improved system readiness based on increased availability of spare parts and a significant reduction in O&S costs that could provide badly needed funds for system modernization. By reducing the length of the supply pipeline, the Army is virtually guaranteed to receive spare parts

quicker. There also will be few, if any, supply stockage zero balances and a significant reduction in overhead since Government facilities and personnel no longer will be needed to store and manage these spares. The Army should also be well positioned to take advantage of Boeing-Lockheed Martin's best commercial practices and "just-in-time" delivery, now known as Velocity Management. More efficient supply management, coupled with a serious reduction in Government overhead will reduce the O&S cost burden substantially.

The current Apache PVS proposal comes with significant performance guarantees that should reduce the average flying-hour cost approximately 20 percent, reduce the Army's investment in inventories, and improve requisition fills, which ultimately will have a positive impact on fleet readiness. The contractor will be allowed to share additional cost savings above and beyond those that are guaranteed. This savings incentive, along with increased competition as more logistics service companies seek to enter the expanding market, should provide even greater savings opportunities.

Though there seems to be definite advantages to PVS, there are several disadvantages that must be considered. The biggest disadvantage is the presence of civilian contractors on the battlefield. Although contractors have worked with operational units for years, including service in Operation Desert Storm, the changes in mission and scope caused by their presence are significant. What is in the best interest of national defense ultimately will determine the agreement reached. [Ref. 16]

AMC provides a critical service in life-cycle cost management. From their organizational PMs, to their support of external PMs, and their job to provide sustainment

for the Army's weapon systems, AMC is a major player in the Army's effort to reduce life-cycle cost of its systems.

D. TRAINING AND DOCTRINE COMMAND (TRADOC)

The final key player in acquisition and life-cycle cost management is TRADOC. TRADOC is the Army's primary "user representative" in the materiel acquisition process. TRADOC performs assigned materiel and related functions for operations research and analysis, evaluation of products of the requirements determination process, operational and organizational planning, logistics support planning, and quantitative and performance requirement specifications for materiel systems, and other combat development functions required by the Army. As the Army's principal CBTDEV, TRADOC guides, coordinates, and integrates the total combat development effort of the Army. Combat developments are a major component of force development and encompass the formulation of concepts, doctrine, organization, materiel objectives, requirements, and operational test and evaluations (OT&E) of products of the requirements determination process. As the Army's primary CBTDEV/TNGDEV, TRADOC is the Army's architect for the future and is charged to chart the course for the Army. [Ref. 11]

TRADOC influences the life-cycle costs in their requirements generation process. The requirements determination is critical in how a system is designed and ultimately supported. Critical decisions made by the CBTDEV can lock in life-cycle costs for a weapon system. It is essential that TRADOC work closely with the PM and AMC. It is also critical that TRADOC provide adequate user support in development and testing of

new systems to ensure we are getting the best quality system at the lowest possible life-cycle cost.

E. SUMMARY

The DoD's shift in focus to life-cycle cost management in today's acquisition and sustainment of weapon systems has caused several changes in the Army. The Army has shifted its focus to life-cycle cost management, from the reorganization of the ASA(RDA) to ASA(ALT) incorporating logistics with acquisition, the assignment of life-cycle cost responsibility to PM's and AMC, and the implementation of several life-cycle cost focused programs such as the Total Ownership Cost IPT, CAIV, SEP, IPPD, OSCR, MTS, and PVS. It takes a total team effort between the AAE, AMC, PEOs, PMs, and the combat developer, TRADOC, to ensure that life-cycle cost is at the forefront in all weapon system acquisitions. In the next chapter, we will look at how four commercial businesses are organized to manage life-cycle costs for the product or service they provide and for the equipment they purchase to provide their customers products and/or services.

III. COMMERCIAL BUSINESSES

Total ownership cost of a weapon system encompasses development, production, operations, support, and disposal. The DSAC (Defense Systems Affordability Council) believes costs in all ownership cost categories are too high and can be reduced substantially if we better emulate the best practices of the public and private sectors. [Ref. 17]

In this chapter I describe the methodology used, including how the four commercial businesses I later analyze were selected, how the information was collected, and why this information is important. Then I will introduce the four commercial businesses and how they are organized to develop, produce, and sustain their product and organized to develop, procure, and sustain their capital equipment.

A. HOW COMMERCIAL BUSINESSES WERE SELECTED

To provide a good foundation for this research, I selected the commercial businesses to be studied based on several criteria. First, I wanted businesses that were highly successful and known throughout the country for the product or service they provide. This is important to establish a credible reference for successful organizations. Next, I wanted to select a mix of businesses, including those that provided its customers with a product and those that provided its customers with a service to illustrate any differences in how service providers are organized. I found businesses that interfaced daily with military services either through providing products or services or being involved in the services' Training With Industry Program (TWI), were more willing to share their information.

B. HOW INFORMATION WAS COLLECTED

To gain meaningful insight into the life cycle cost control methods of the commercial world, I developed a survey (See Appendix. Equipment Life-Cycle

Management Survey) designed to provide a general overview of how a company manages procurement, operations, and sustainment functions. I felt it important to consider the organizational structures and how they related to product/service development, as well as internal capital equipment (less facilities) procurements. The internal capital equipment information is significant because there seems to be a trend in DoD to study commercial best business practices focusing on how commercial businesses develop, produce, and sustain a product for their customer instead of how they go about buying and sustaining the internal capital equipment to support their product or service. I believe the study of how internal capital equipment is critical because, as the U.S. Army, we are also buyers of capital equipment (tanks, trucks, missiles, computer, etc.) that is needed to provide our service to the United States.

The survey developed for this thesis was focused on obtaining information related to the organizational structures and management responsibilities with respect to procurement, production, operations, and sustainment functions of products and capital equipment within each business. The survey contained questions that focused on the following:

- Describing the commercial businesses organizational structure especially the structures related to the following questions.
- What organizational units or departments are responsible for product development?
- What organizational units or departments are responsible for product post-sale sustainment and customer support?
- What organizational units or departments are responsible for developing requirements for internal capital equipment?
- What organizational units or departments are responsible for managing the purchase, delivery, and installation of capital equipment?

- What organizational units or departments are responsible for sustainment of capital equipment?

In obtaining the information needed for this thesis, I chose to use a written survey in order to provide the businesses surveyed the time and resources to construct accurate responses. The written survey allowed the respondents the chance to use several resources (people, organizational charts) within their organization to get correct information and also provide a written document for approval by their chain of command and public affairs for release. A telephone interview would not have solicited the detailed responses needed nor provide the organizational structures.

The information collected via the survey is presented in the following sections and will be used in analysis and comparison with the current Army structure. The following list shows the commercial businesses who responded to the survey and who the individual respondents of that business were:

- Lockheed Martin Missiles and Fire Control – Information collected from several LMMFC departments, consolidated and presented by Major Keith A. Flail, U.S. Army, Training with Industry Student.
- Boeing Company (Commercial Airplane Group) – Information collected from several Boeing departments, consolidated and presented by Mr. Kevin R. Heise, Regional Director, Airline Analysis and Marketing.
- Communications Systems Company – This Company chose to remain anonymous and will be referred to as Communications Systems Company throughout this thesis. Information collected from several departments, consolidated and presented by one point of contact.
- Federal Express – Information collected from several FEDEX departments, consolidated and presented by Mr. James H. Idell, managing director for U.S. Vehicle/GSE Maintenance.

The analysis will involve breaking down the commercial businesses and the U.S. Army's current structures into simplified organizational structures focusing on the tasks of

acquisition of products and capital equipment, operations and sustainment or their product and capital equipment, and the users of the product, service and capital equipment. This analysis will compare the selected businesses organizational structures with how the U.S. Army is currently structured, identifying advantages and disadvantages of these structures using recognized organizational design and structure theories.

C. COMMERCIAL BUSINESS DESCRIPTIONS

The following four sections provide descriptions of how the four commercial businesses surveyed develop, produce and sustain their product or service. In addition the following four sections provide descriptions on how these four commercial businesses develop requirements, purchase, and sustain the capital equipment used in development and production of their product or to provide their service. The descriptions of each business were developed from their survey responses [Ref(s). 18-21].

1. Lockheed Martin Missiles and Fire Control – Orlando, Florida

Lockheed Martin Missiles and Fire Control develops, manufactures, and supports advanced combat systems and missile, rocket, and space systems. The company is the Corporation's lead business unit for research, development, and production of electro-optic and smart munitions systems and is a pioneer in the field of versatile, high performance missile and rocket technology, sensors, fire control systems, and tactical missiles.

a. Development, Production and Sustainment of LMMFC Products

When LMMFC begins the development of a new product for a customer, they assign a Program Manager to oversee the entire development. The Program Manager works for a Vice President (reports directly to LMMFC President, see Figure 2) who controls several programs within a certain specialty area (Air Defense Programs, Strike

Weapons Programs, Fire Control and Sensors Programs, or Anti-Armor Programs). Figure 3 displays one of the specialty programs within LMMFC. The Program Manager is supported by a program office, which is a matrix organization that forms Integrated Product Teams (IPDTs) to manage the development of its product (see Figure 4). The Program Office can consist of individuals from all functional areas within the company, including engineers, systems, finance, logisticians, contracts, procurement, business, planning, production, and manufacturing. The purview of the Program Manager is determined by the contract they have with the customer. It is conceivable that the Program Manager could manage the total life-cycle of a product, but only if the contract is so written. The PM normally manages the life-cycle only to the extent of the current contract requirements for deliverable hardware to the customer. If follow-on contracts are awarded, the PM “could” manage the life-cycle.

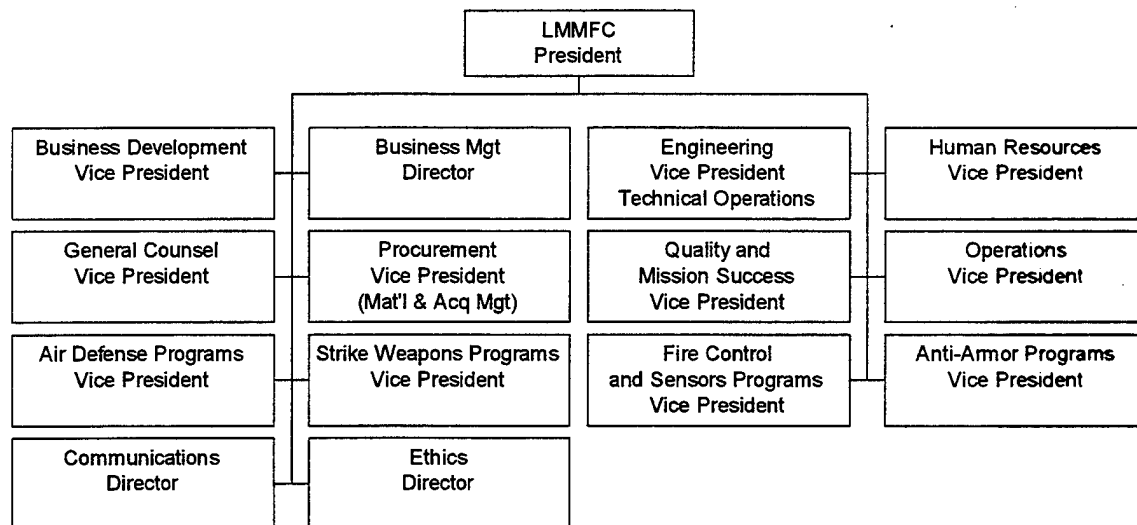


Figure 2. LMMFC Organizational Structure “After Ref. [18].”

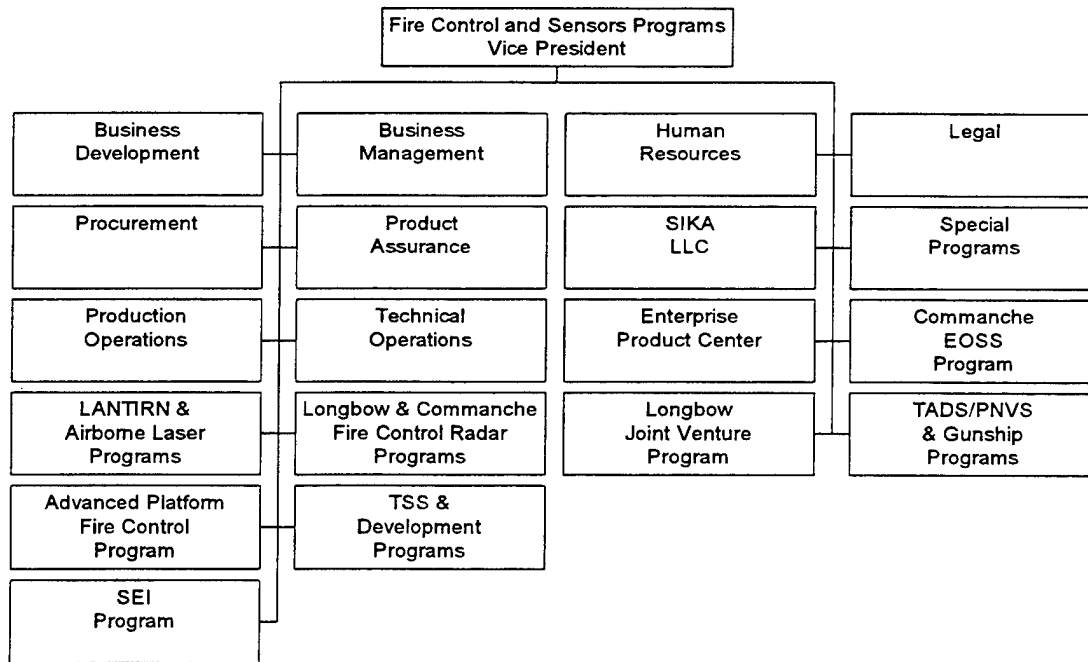


Figure 3. LMMFC Sample Programs Organizational Structure “After Ref. [18]”

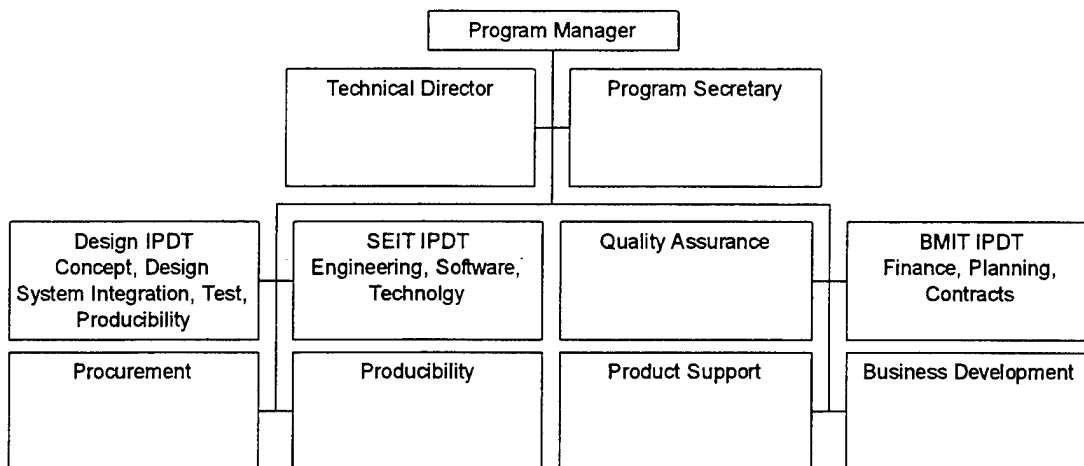


Figure 4. LMMFC Sample Program Office “After Ref.[18]”

The PM has overall responsibility for the development of the product. Within the PM office, the Technical Operations (Engineering) (see Figure 3) personnel lead the product development effort with input from other functional areas. Following development of the product, the Production Operations (see Figure 3) personnel take the

lead in the production phase until the product is delivered to the customer. If a sustainment contract, such as Prime Vendor Support, is awarded following development and production, the Product Support (see Figure 4) personnel would have the lead.

Product Support is responsible for sustainment and post-sale support. They are involved early in the development of the product to ensure Operations and Support considerations such as reliability, maintainability, etc. are well represented to develop the most cost-effective product.

b. Developing Requirements, Purchase, and Sustainment of LMMFC Capital Equipment

LMMFC purchases capital equipment to execute their contracts for their products. Capital equipment requirements are identified during a program's proposal process. This Request for Capital Equipment is submitted as part of the proposal, and policy dictates that the request's dollar value cannot exceed a certain percentage of the contract value. The request is very detailed and includes the purpose, need, spares and parts requirements, warranty information, service contracts, duration of use, reliability, and maintainability.

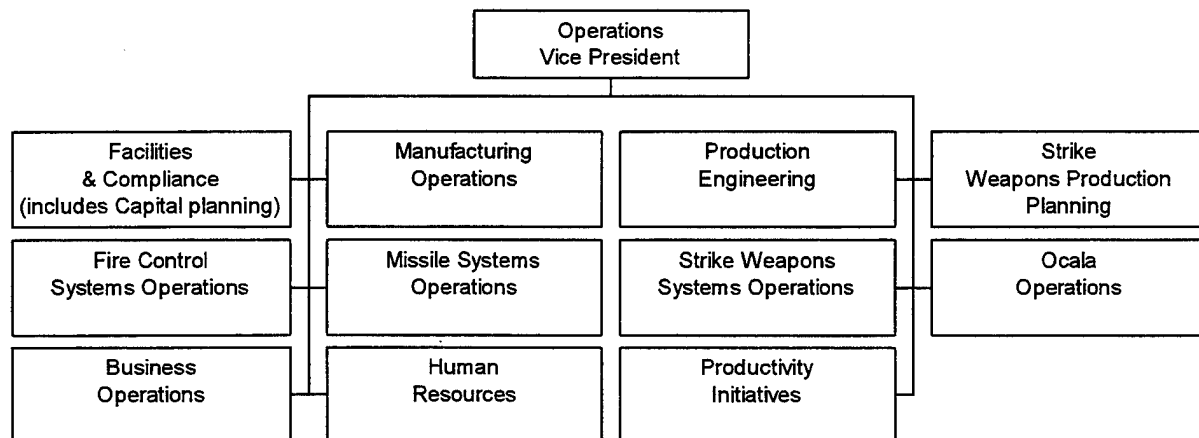


Figure 5. LMMFC Operations Organizational Structure "After Ref. [18]"

The PM provides the capital equipment requests to the Capital Planning group (see Figure 5), which fall under the Facilities and Compliance department which reports to the Operations Vice President, for consideration. The Capital Planning group will conduct a search across the entire LM Corporation for the requested resource, or a similar one that will accomplish that requested resources intended purpose. If the requested resource already exists somewhere else within the LM Corporation, every effort will be made to “borrow” this resource before purchasing a new piece of equipment.

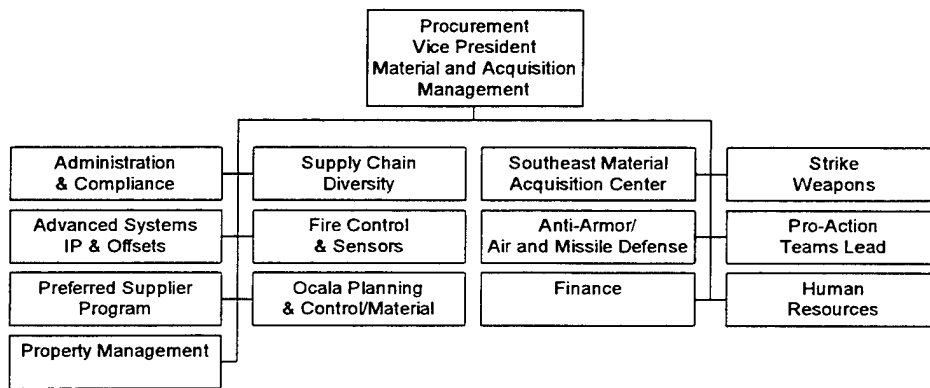


Figure 6. LMMFC Procurement (Mat'l and Acq Management) Organizational Structure
“After Ref. [18]”

If the piece of capital equipment is purchased, it is received, rolled into a property management account, labeled, and assigned to an appropriate custodian. This property management account and it's assigned custodian work for the Director for Property Management who reports directly to the Procurement (Material & Acquisition Management) Vice President (see Figure 6). The Property Management department maintains the automated system/database, which tracks all property and respective custodians. The property management system is subjected periodically to thorough

internal and external audits. Custodians are held responsible for the equipment, to include calibration, maintenance, etc.

2. Boeing Commercial Airplanes Group

The Boeing Company is the largest aerospace company in the world. It is the world's largest manufacturer of commercial jetliners and military aircraft, and the nation's largest NASA contractor. In terms of sales, Boeing is the largest U.S. exporter. Total company revenues for 2000 were \$51 billion.

The world's largest producer of commercial jetliners, Boeing Commercial Airplanes Group maintains its leadership by focusing intensely on customers and the dynamic, complex air travel marketplace they face. As the air transport industry changes to a world of alliances, "virtual airlines" and rapidly shifting markets, Boeing has developed a family of products and services that deliver total customer solutions to these evolving challenges.

a. Development, Production and Sustainment of Commercial Aircraft

The Boeing Commercial Airplane Group has three interrelated but distinct groups that get a product to market and follow it through its life-cycle. Two of these groups work for the Vice President for Airplane Programs, who reports directly to the President of Commercial Airplanes (see Figure 7). These two groups are the Product Development and Strategy Group and the Airplane Program Office's (e.g. 737 Program, 757 Program, etc.) (see Figure 8). The third group key to getting a product to market and managing it through its life-cycle is Commercial Airplane Services, who reports directly to the President for Commercial Airplanes (see Figure 7 and 9). The Product Development and Strategy group determines what product will best serve the customers'

needs. They also do the basic engineering to decide if what the customer wants is feasible to design and build. Once the Product Development and Strategy group decides that Boeing can build a product to service the customers' needs and also that it will be a profitable for Boeing, a Vice President (VP) is assigned to lead the program (see Figure 8, e.g. 737 Program, 757 Program, etc.). His job is to oversee the engineering and production of the airplane and reports directly to the Vice President for Airplane Programs. The Airplane Program office then designs the airplane with high reliability and ease of construction to minimize life-cycle costs. In addition, once the airplane is in service, the airplane program office is responsible for any redesigns needed. This program VP has profit and liability responsibility for his airplane.

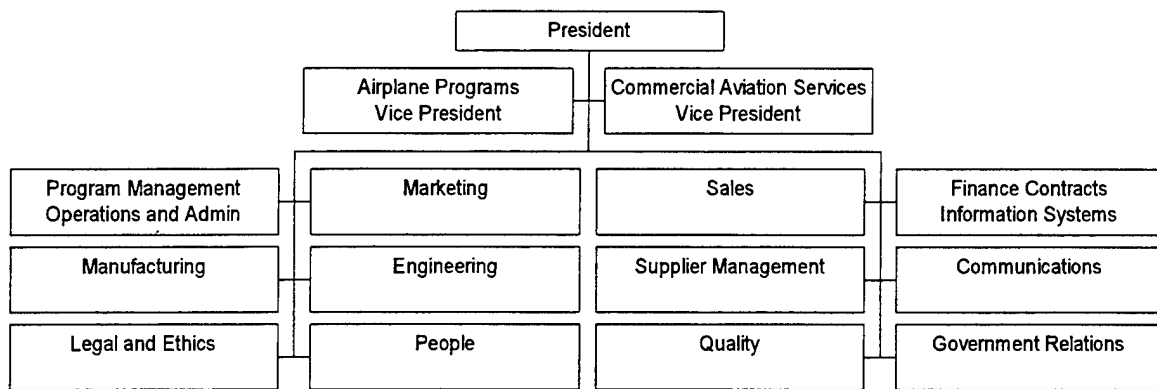


Figure 7. Boeing Commercial Airplanes Organizational Structure “After Ref. [19]”

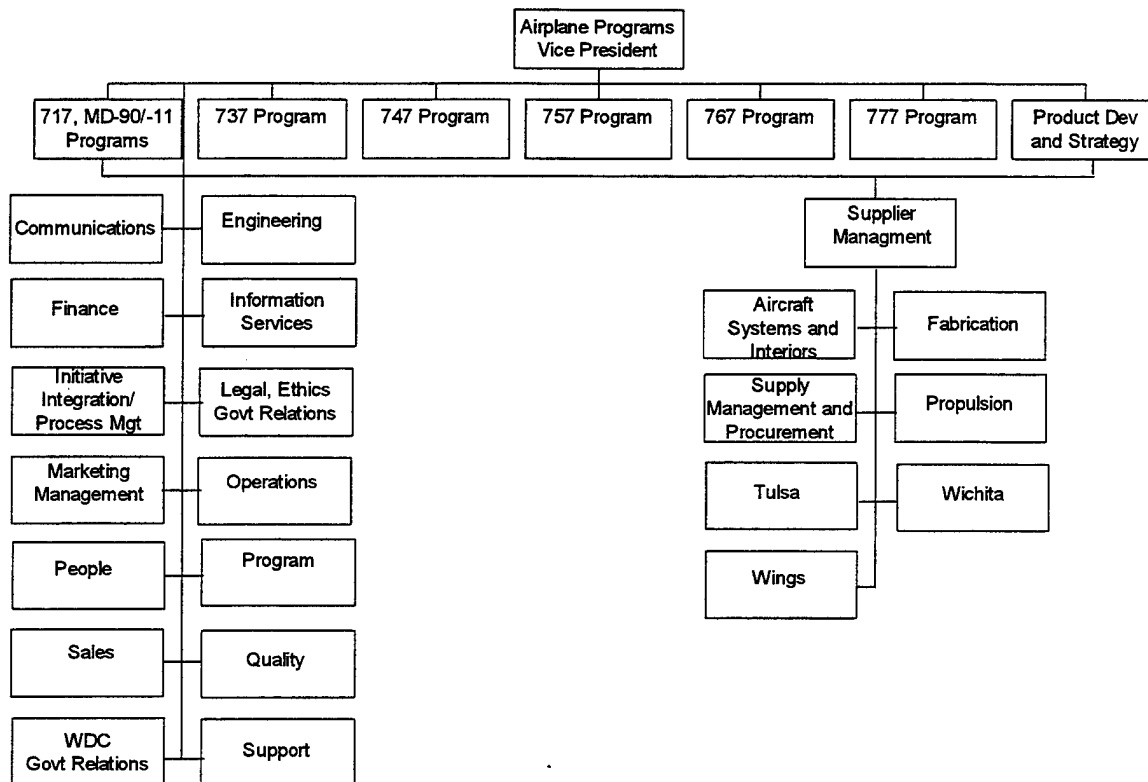


Figure 8. Airplane Programs Organizational Structure “After Ref. [19]”

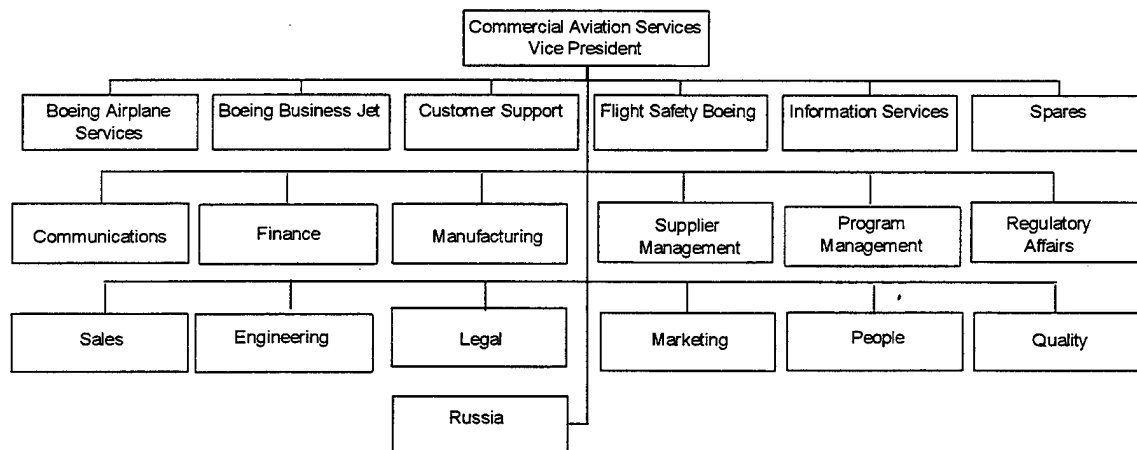


Figure 9. Commercial Aviation Services Organizational Structure “After Ref. [19]”

Once the plane is designed, it goes to the Manufacturing group. This is a separate organization that reports directly to the President of Commercial Airplanes (see Figure 7). By being a separate organization that works with all airplane programs the manufacturing group is able to ensure consistency and commonality among manufacturing processes, equipment, and airplane parts across all airplane models. This consistency and commonality in manufacturing across all airplane programs helps to reduce life-cycle costs throughout Boeing by reducing manufacturing overhead.

Once an airplane is produced and entered into service, the Customer Support Division, which falls under the Vice President for Commercial Aviation Services (see Figure 9), is responsible for providing customer support for the airplane. They analyze the data as the product matures and decide on changes that need to be made to ensure safety and performance. The Customer Support Division interacts with the Airplane Program Offices continuously to ensure problems identified by customers and identified in their analysis of airplane data are translated into design changes, which can be incorporated in new airplanes. In addition, the Customer Support Division has a Logistics Support element, which is responsible for all logistics for the airplanes.

b. Developing Requirements, Purchase, and Sustainment of Capital Equipment

Once a product has been developed, that product's program office determines the capital equipment requirements to produce the airplane and generates a request for capital equipment. The Facilities department, within the Operations division of Airplane Programs, (see Figure 8) receives all capital requests, verifies the request and costs, coordinates the capital budget approval, and then manages the capital expenditures

including the purchase and installation of equipment. Once equipment is installed and in use, the Facilities department has management responsibility for this equipment.

The responsibility of life-cycle management for capital equipment rests with the equipment engineer in the Facilities Division at the time the equipment is purchased. Equipment is selected for design and built for function, rather than maintainability; however, the equipment must meet some reliability guidelines.

3. Communications Systems Company

Communication Systems Company provides secure communication and information solutions that integrate custom-developed and commercial off-the-shelf products for the military and commercial markets. It designs, integrates, and supports strategic and tactical battlefield communication systems worldwide. It also provides environmentally hardened and special packaging of computer equipment and peripherals for both commercial and military applications. Communication Systems also offers advanced technology solutions in distance learning and video-on-demand delivery systems to government and commercial customers.

a. Development, Production and Sustainment

Proposal and development of communications products is done by the Strategic Planning and Business Development organization that reports directly to the President of Communications Systems (see Figure 10). Once the product is developed it is assigned to a Program Manager who works for the Vice President and General Manager of the Program Group in which that program is assigned (see Figure 11). The program manager has the following responsibilities:

- Responsible for the product throughout its life-cycle.

- Ensures that the product meets the customers' needs in both manufacturing and testing.
- Works hand-in-hand with the Operations and Materials Management division (see Figure 10) who is responsible for all manufacturing aspects of production to include procurement of materials, manufacture of product, dealing with sub-contractors, and moving the product to warehouses.
- Handles the actual interface with the customer.
- Provides the necessary customer support and ensures the product is meeting the customer needs.
- Ensures customer satisfaction during product fielding and work issues after product is fielded.

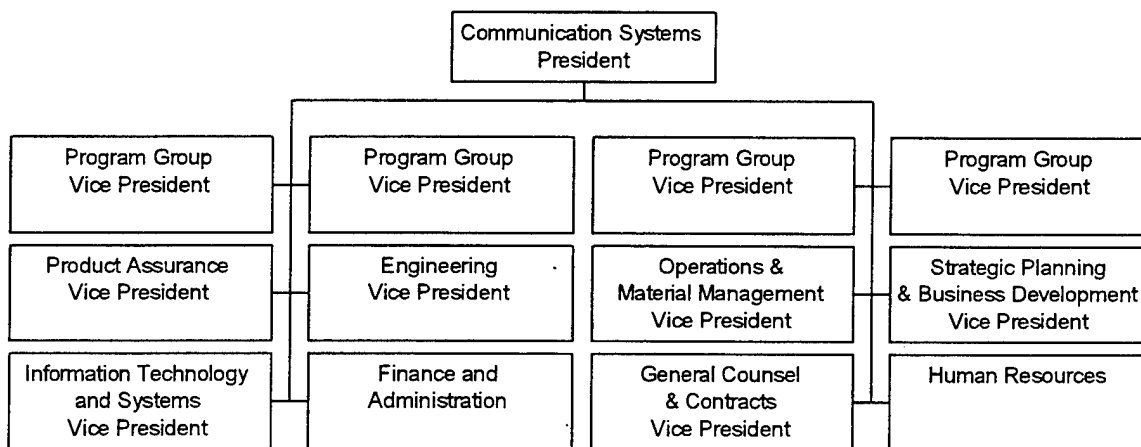


Figure 10. Communications Systems Company Organizational Structure
"After Ref. [20]"

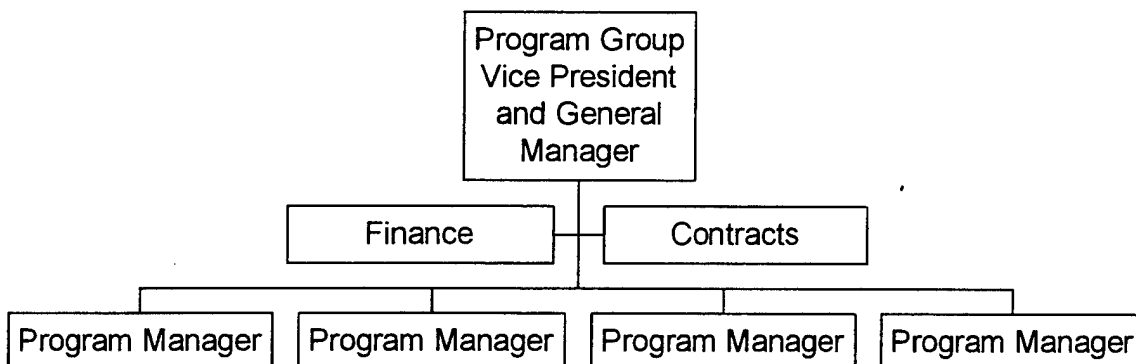


Figure 11. Communications Systems Program Group Organizational Structure
"After Ref. [20]"

Following the fielding of a product, sustainment of the product is handled by Regional Support Facilities, but sustainment is still under the responsibility of the program manager. These Regional Support Facilities provide local area supply and maintenance and are staffed by Communication Systems technicians.

b. Development of Requirements, Purchase, and Sustainment of Capital Equipment

Communication Systems Company purchases capital equipment to execute their contracts for their products. Capital equipment requirements are identified by the Strategic Planning and Business Development organization during a program's proposal process. Once a program has been established the capital requirements identified by the Strategic Planning and Business Development are submitted by the program office to the Vice President for Operations and Material Management (see Figure 10) who reports directly to the President for Communication Systems Company. The request is very detailed and includes the purpose, need, spares and parts requirements, warranty information, service contracts, reliability, and maintainability.

Once the Operations and Material Management department approves the capital request, this department is also responsible for the purchase and installation of the equipment to be used in production and/or development of the product. The sustainment of the purchased capital equipment is also the responsibility of the Operations and Material Management group. The majority of this sustainment is performed under contract through outsourcing along with the installation of the capital equipment.

4. Federal Express (FEDEX)

Federal Express, headquartered in Memphis, Tennessee, is the world's largest express parcel delivery company. FEDEX delivers approximately 3.2 million parcels

daily and operates a fleet of more than 50,000 vehicles, 50,000 pieces of ground support equipment (GSE) and 650 planes worldwide.

Since FEDEX is a service provider, I only discuss the purchase and sustainment of their capital equipment, which consists mainly of their truck and airplane fleets.

The success of the massive FEDEX transportation network is greatly reliant on the readiness of its fleet. The company's couriers drive millions of miles daily in the U.S. alone. The leadership at FEDEX has long recognized the significance of the O&S portion of the equipment life cycle in terms of corporate profitability. It's no accident that the procurement management structure at FEDEX is organized to incentivize performance, reliability, and long-term affordability by putting those responsible for the maintenance of their fleet also responsible for the procurement of their fleet. Figure 12 below outlines the organizational structure as provided by FEDEX. The Vice President for Strategic Sourcing and Supply has eight (8) directorates with explicit responsibility for supply, strategy, and sourcing (see Figure 12).

The Vice President for Vehicle/GSE Maintenance has four (4) directorates and is responsible for maintenance of over 100,000 pieces of equipment worldwide (see Figure 12). The most significant aspect of this structure in terms of life cycle cost control, is that the VP for Vehicle/GSE Maintenance has the lead in procurement and purchase of trucks for the FedEx fleet. Said differently, the person responsible for logistics of the equipment has ultimate responsibility for procurement. To facilitate this relationship, the Director of Procurement is co-located with Maintenance and is permanently detached from the Strategic Sourcing and Supply Department to the VP for Vehicle/GSE Maintenance.

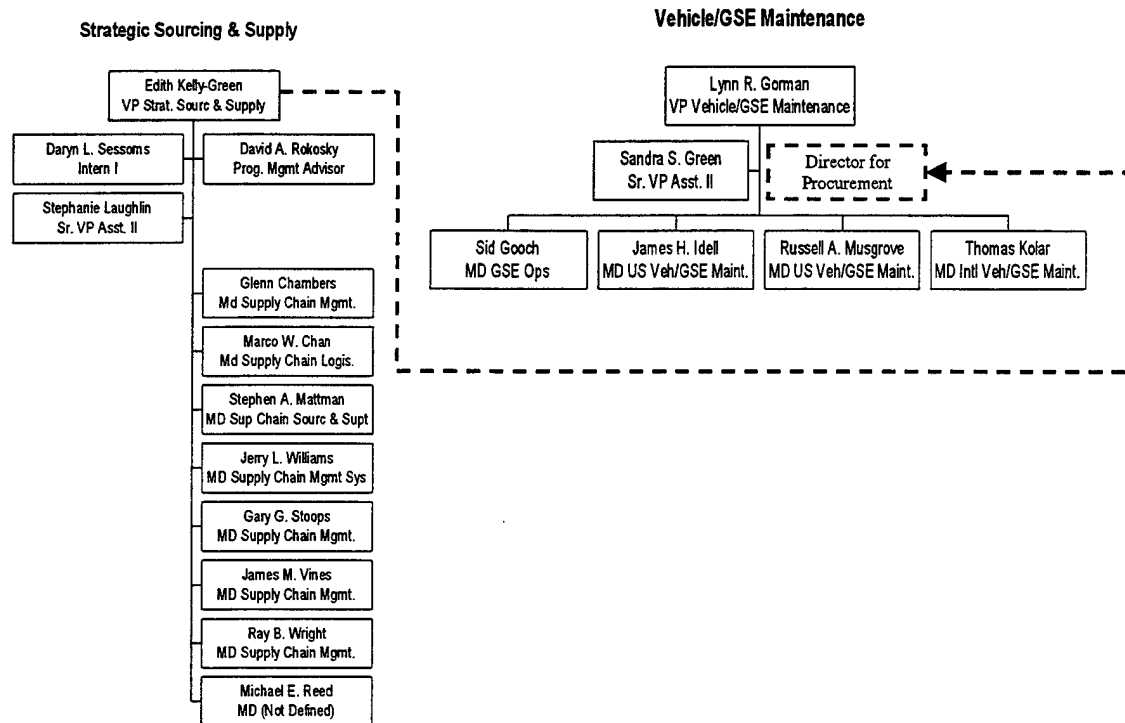


Figure 12. FEDEX Organizational Structure "After Ref. [21]"

The VP for Strategic Sourcing and Supply has staff input responsibilities to the procurement process, but it is the VP of Vehicle/GSE Maintenance that is accountable to the President of FEDEX for everything from source selection of vehicle vendors, to performance evaluations Procurement personnel.

Mr. James H. Idell, the managing director for U.S. Vehicle/GSE Maintenance at FEDEX cites that,

... one of the greatest advantages of this organizational structure is in providing incentives for the reduction of downstream acquisition costs in an area where complete and reliable data on actual operating and support costs are difficult to estimate. By organizing so that the people in the company most knowledgeable of O&S issues implement strategic procurement decisions, FEDEX ensures that the equipment procured to provide service to the customer, is done with reliability and maintainability as key factors. [Ref. 21]

D. SUMMARY

This chapter described how four commercial businesses are organized to manage costs in the development and production of their products and the life-cycle costs of the capital equipment they purchase. This chapter also provided the methodology behind the selection of these companies and how the information was collected. These descriptions along with the information in Chapter II are used in the analysis provided in Chapter IV. The analysis will involve breaking down the commercial businesses and the U.S. Army's current structures into simplified organizational structures focusing on the key functions of acquisition of products and capital equipment, operations and sustainment of their product and capital equipment, and the users of the product, service and capital equipment. I will analyze why it is important for these commercial businesses to organize around the key functions that directly link to their goals and compare and contrast how the Army is currently organized to achieve its goals. This analysis will look at these organizations from a system's perspective focusing on how the U.S. Army and the four commercial businesses have organized around specific functions to achieve their goals.

IV. ANALYSIS

Over the past twenty years, a new management framework has emerged revolutionizing the way American companies think about production. This new integrated approach to product design and manufacturing replaced old mass production methods. Two principles comprise the heart of the new framework; 1) customer satisfaction is paramount and 2) the company is a system of processes, one feeding into another that produce the products and services that customers purchase [Ref. 22]. As a result, commercial industry has scrambled to restructure organizations around a set of goals directed to that end. As indicated by the descriptions in Chapter III, leading edge commercial businesses and, as reflected in Chapter II, the U.S. Army have organized into hybrid and matrix structures to maximize this integrated approach. Some of the advantages realized by organizing into hybrid and matrix organizations are:

- Fast response, flexibility in an unstable environment
- More efficient use of resources and economies of scale
- Development of general and functional management skills
- Interdisciplinary cooperation and expertise available to all divisions
- Fosters concern for customer needs
- Assignment of responsibility for product problems
- Effective coordination both within and between divisions
- Alignment of corporate and division goals
- Flexibility in divisions and efficiency in functional departments

Organizing in these structures has allowed companies to realize the advantages listed above, but their success seems to depend not only on their organizational structure but also on how and where they assign responsibility for the key functions necessary to achieve their goals.

The descriptions in Chapter III allowed me to identify the part of the organization responsible for managing costs associated with developing products/services for customers and contrast it to the part of the organization responsible for managing costs of the company's own capital equipment. In this Chapter, I will analyze why it is important for these companies to organize around the key functions that directly link to their goals and compare/contrast how the Army is currently organized to achieve its goals. In my analysis I will examine these organizations from a system's perspective, focusing on how the U.S. Army and the four commercial businesses have organized around specific functions to achieve their goals.

To reduce the complexity of the organizational structures of the companies, I developed a model for simplifying the organizational structures and isolating key functions. Departments primarily responsible for Operations and Sustainment cost control were designated as "Type L" (Logistical Operations and Support). Departments responsible for sourcing & procurement were designated as "Type A" (Acquisition). Departments primarily involved in actually using and operating the equipment were categorized as "Type U" (User). In addition to these categories, only departments directly involved in one of these three functions and their relative position to the executive levels of the company were illustrated.

A. SIMPLIFIED ORGANIZATIONAL STRUCTURES – COMMERCIAL BUSINESSES

Analyzing the simplified structures for the commercial businesses that provide products to their customers, it appears that they have organized to focus on the Type A function to achieve their goal of providing their customer a quality product in the most cost efficient manner, thereby generating a profit for their company. Their profit depends on the efficient development and production of their product. For LMMFC, Boeing, and Communications Systems Company, the acquisition and sourcing function is key to achieving their goal of providing a quality product to meet their customers needs, while focusing on reducing the costs in areas such as item procurement, development, and production processes that directly affect their profits (see Figures 13, 14, 15). They are organized around this function to optimize product quality, sourcing, and procurement costs. To achieve these companies' goals of providing a quality product in the most efficient and cost effective manner, and to produce a profit for their stakeholders, a strategy focused on the Type A function is essential.

These companies have designed their organization with the use of hybrid and matrix structures to take advantage of the integration of departments and individuals who are experts in functional areas such as engineering development, supply procurement, production management, and quality control. By organizing this way and integrating these functional areas, these companies have aligned their organizations around those key functions so that their goals can be achieved. In these organizations, it is critical for those responsible for the acquisition and sourcing function to have the knowledge, skills, and expertise to ensure the most life-cycle cost efficient development and production of their product. This integration of functional areas within product divisions ensures that all

areas related to the development and production of quality products are equally considered when developing products for their customers.

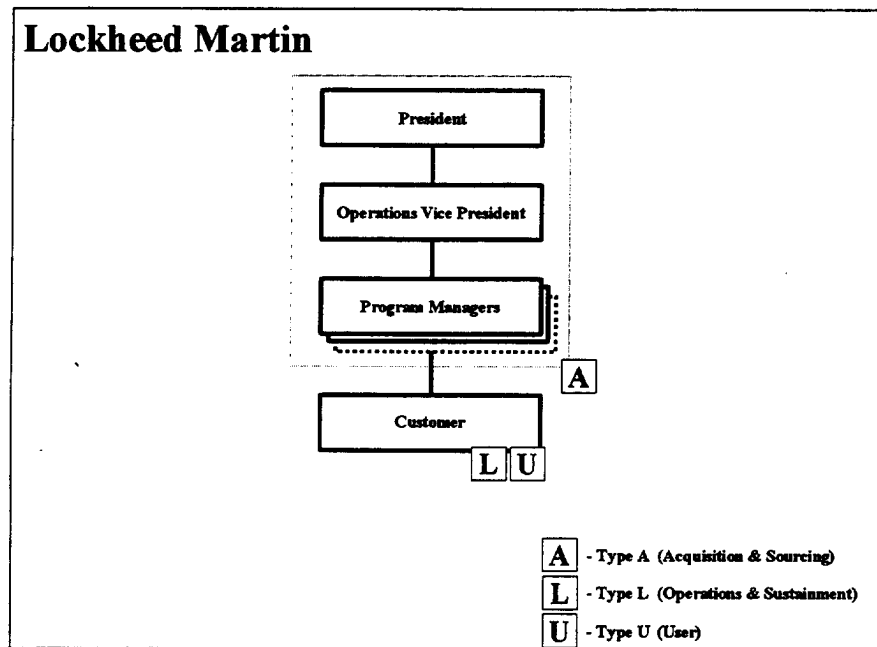


Figure 13. LMMFC Simplified Organizational Structure Products

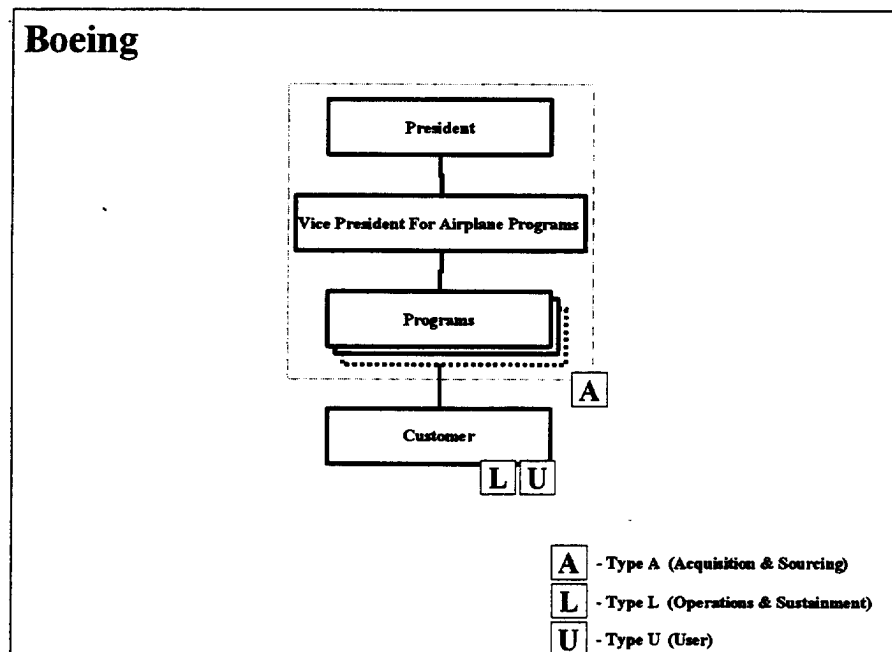


Figure 14. Boeing Commercial Airplanes Simplified Organizational Structure Products

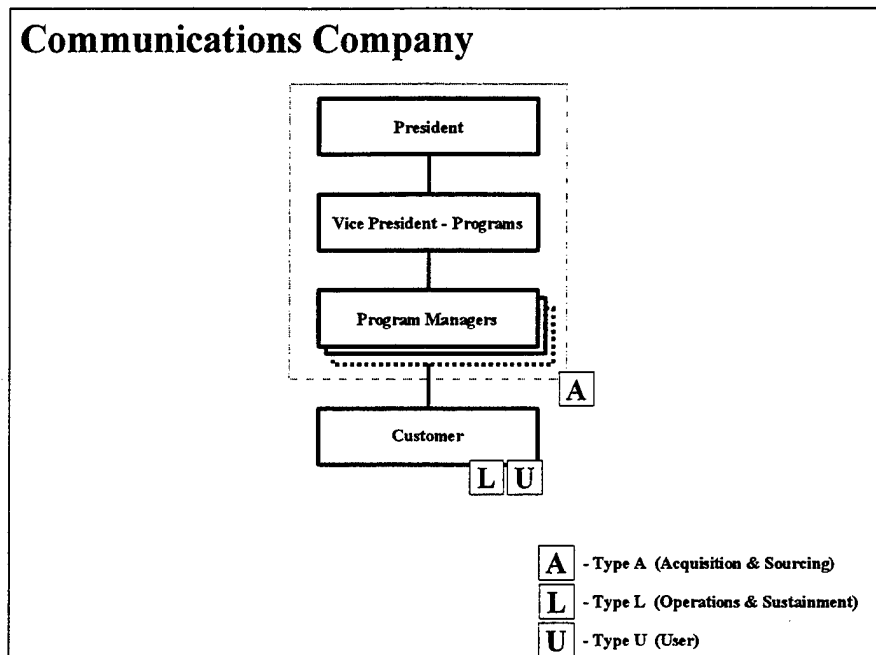


Figure 15. Communications Systems Company Simplified Organizational Structure
Products

In addition, the Type L function is performed by the users of these companies' products (see Figures 13, 14, 15). When a product is sold to a customer, this generally signals the end of cost management by the producer. In addition, warranties and sustainment contracts are normally profit making (or at worst, break-even) endeavors for the manufacturer -- they are usually bought and paid for by the customer.

As one can see, total life-cycle cost management of the product is not critical to commercial businesses providing a quality product to its customers at a profit to their stakeholders. The cost management necessary to their success is in the development, acquisition, and production of their product. The O&S portion of the product is borne by the customer and in the end, can be additional profit for the businesses in the form of follow-on maintenance and support contracts to include warranties.

In contrast to commercial businesses that provide a product for their customers, FEDEX, a service provider, is organized to focus on the Type L function (see Figure 16). FEDEX's profit lies in their ability to provide a timely, reliable service. FEDEX's goal of timely, reliable service is dependant upon the operation of their fleet of ground and air vehicles. In order to ensure timely and reliable service, they must focus their organization on the operation and sustainment of their fleet to include the acquisition of reliable and maintainable equipment. The costs associated with these items comprise a great portion of the company's assets.

FEDEX has aligned their organization around the functions that allow them to achieve their goal. They have assigned the responsibility of acquisition and sustainment of their operational fleet to those who are knowledgeable and have the skills and incentives necessary to ensure they acquire a fleet that is easily maintainable and reliable. As seen in their simplified organizational model (see Figure 16), they have organized to explicitly control total life-cycle costs and ensure the readiness of their fleet by placing the directorate responsible for Type A functions subordinate to the department responsible for Type L functions.

One of the essential elements to the success of achieving goals implicit in any particular organizational structure is the assignment of a "champion" or sponsor -- someone who promotes the critical ideas necessary to achieve that organization's goal. This champion must understand the business significance of his role and the role of his department within the organization. By assigning the acquisition and sourcing functions to the person responsible for the operation and sustainment functions within FEDEX, FEDEX is ensuring that operations and support costs, maintainability, and reliability are

forefront in all acquisition of their capital equipment. This alignment ensures that those with the knowledge and expertise in relation to operation, sustainment, and maintenance of their equipment are responsible for the acquisition of this equipment.

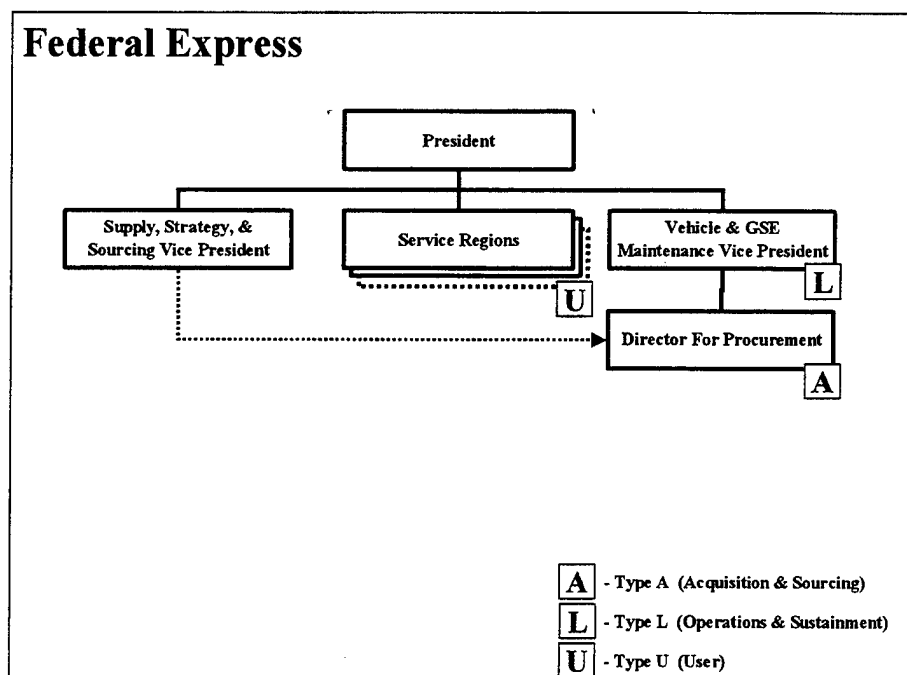


Figure 16. Federal Express Simplified Organizational Structure

Clearly, total life-cycle management is critical for a service provider like FEDEX. Their profits are directly related to cost control of the operations and support portion of their capital equipment to include the cost of acquiring their capital equipment. Survey comments indicate that this is the foundation for the decision to organizationally place procurement functions subordinate to O&S functions. As explained by Mr. James H. Idell, the managing director for U.S. Vehicle/GSE Maintenance at FEDEX:

... one of the greatest advantages of this organizational structure is in providing incentives for the reduction of downstream acquisition costs ... by organizing such that the people in the company most knowledgeable of O&S issues implement strategic procurement decisions, authority is sufficient for responsibility. That is, the goal is controlled by the people that will eventually do the work. [Ref. 21]

Similar to FEDEX, two of the commercial businesses, Boeing and Communications Systems Company, who provide products, change their focus when they are procuring capital equipment for their own use. As depicted in the simplified organizational structures of Boeing and Communications Systems Company, Type A and Type L functions are performed by the same department (see Figures 17, 18). This is important because the acquisition, operation, and sustainment costs of their capital equipment affect their profits by contributing to their production overhead. As the costs to acquire and sustain capital equipment increase, the cost to produce the company's product increases, reducing their profit. This is why the capital equipment process and the analysis of the total life-cycle cost of capital equipment is critical in a company's decision to enter into the production of a product. If the cost of the acquisition and sustainment of the capital equipment needed to produce a product is such that a company cannot realize a significant profit from its sales, they will not produce this product.

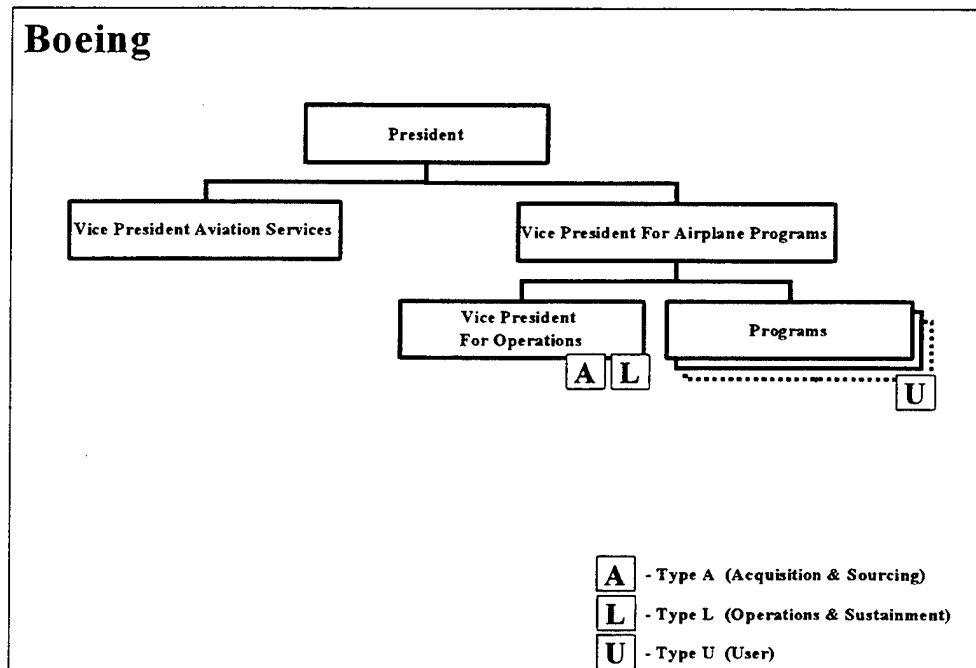


Figure 17. Boeing Simplified Organizational Structure Capital Equipment

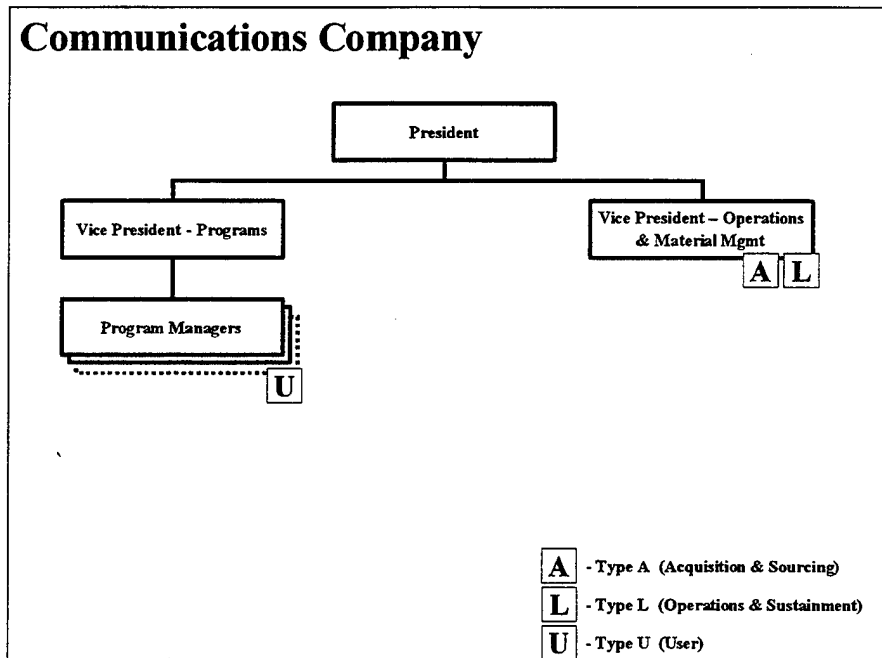


Figure 18. Communications Systems Company Simplified Organizational Structure
Capital Equipment

Though all of the commercial businesses who provide a product identified total life-cycle cost management for their capital equipment as important, they indicated that they could do a better job of managing life-cycle costs within this area of their business. This can be attributable to the nature of product or service they provide. For example, manufacturing companies seem less susceptible to loss of profit from runaway O&S costs due to the small percentage this cost represents in relation to their overall profits.

B. SIMPLIFIED ORGANIZATIONAL STRUCTURE – U.S. ARMY

Examining the Army's current structure, we see that they are structurally similar to the commercial businesses described in Chapter III, using a hybrid structure along with a matrix structure at the PM offices. As depicted in the Army's simplified structure (see Figure 19), we see that it has a similar assignment of functions as the commercial

businesses structures to provide products: Boeing, LMMFC, and Communications Systems Company. The Army has a clear separation of the Type A function and the Type L function. I believe this is the fundamental problem in today's Army structure.

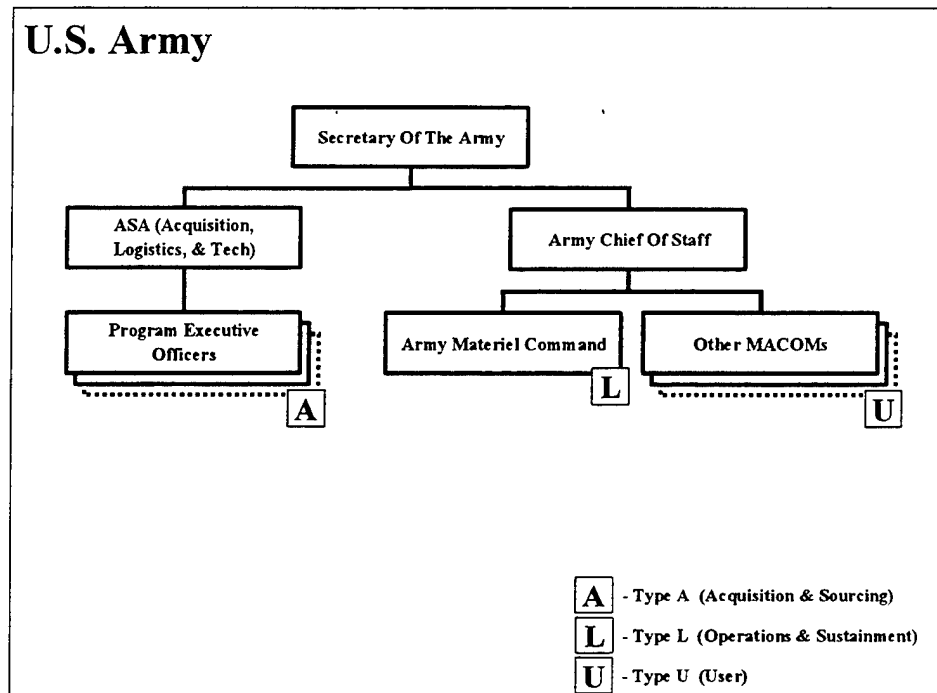


Figure 19. U.S. Army Simplified Organizational Structure

The Army has steadily shifted its goal in acquisition of its equipment from acquisition cost to total life-cycle cost management. As stated in Chapter I, although there are differences in opinion among professionals over how great the ratio of operating and support (O&S) costs are in relation to total life-cycle costs, most agree that: (1) they are substantial, (2) many associated with current Army equipment could have been decreased, and (3) we suffer from decreased readiness, in part due to our inability to control O&S costs for our existing equipment. The shift in the Army's goal to total life-cycle cost management is critical because, as a service provider, the Army should be

focusing efforts and assignment of functions towards its pressing goal; to reduce total life-cycle costs. O&S cost represents 70% to 80% (Ref. 23) of the total life-cycle cost of the equipment procured to provide National Defense. But, as the simplified Army structure shows, the acquisition and sourcing functions are separate from the O&S and user functions. This reinforces the disadvantage exhibited in functional structures by creating a barrier between key functional areas and results in poor coordination and communication across functional departments. These functions, acquisition and sourcing, and operations and sustainment, need to be integrated to ensure the focus of total life-cycle cost management.

The Army has tried to compensate for this misalignment of structure and responsibility roles by assigning responsibility the program managers for O&S costs. But the acquisition personnel do not necessarily have the knowledge or background of O&S cost functions and live by the mantra "cost, performance, schedule" with the acquisition cost implied over the life-cycle cost. This misalignment is reinforced by the reward system for program managers who are rewarded based on fielding a product quickly at the lowest acquisition cost possible. This focus often results in the sacrificing of O&S cost efficiencies in favor of larger procurement quantities or improved system performance without regard for O&S cost implications.

From a systems perspective, the Army has tried to achieve its goal of controlling total life-cycle costs by making changes to their organizational structure, processes, and culture. These changes have not been successful because of the omission of a critical element of functional realignment to achieve their goal within the areas of operations and

sustainment, and acquisition and sourcing, to ensure the roles and responsibilities of these functions are integrated, not separate functional areas.

The Army will likely be unable to achieve its goal until it is able to refocus, realign, and integrate the O&S and acquisition functions and responsibilities in support of reducing the total life-cycle cost of its equipment. Until this shift is accomplished, the Army will continually have acquisition specialists who are driven towards procuring equipment exclusively considering acquisition costs, performance, and schedule.

C. SUMMARY

The Army has attempted to adopt proven commercial best practices in relation to organizational structure. As demonstrated by this analysis, the current Army structure, a combination of a hybrid and matrix structure, is consistent with commercial businesses that provide products and unlike those that provide a service. As the Army functions more as a service provider than a product producer, the current Army structure appears to be misaligned in the key functions related to the acquisition and sustainment of equipment. The Army is not in the business of acquisition and sourcing of a product to sell to a customer for profit. It is an organization that acquires equipment for its own use to provide a service and should be focusing on the total life-cycle cost of the equipment, as FEDEX does, not solely on the acquisition cost.

Reorganization efforts at FEDEX have focused on developing an organization that minimizes O&S costs rather than focusing on sourcing and procurement costs. Without doubt, sourcing and procurement costs are an important part of FEDEX business processes, as it should for the U.S. Army, but the leadership has recognized that O&S costs more directly impact profitability. Although the Army is also a service related

organization, it appears that reorganization efforts most closely reflect those of manufacturing type industries. This appears to be a contributing factor to the existing situation where the Army pays much more to sustain their equipment than to procure.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

By analyzing how the U.S. Army and the four commercial businesses are organized to manage the total life-cycle cost of the equipment used to provide their product or service I have come to the following conclusions:

- The Army has separated the key functions of acquisition and sourcing from operations and sustainment, thereby creating a misaligned organization.
- In an effort to adopt best commercial practices the Army has modeled itself after product producing companies vice service related companies.

Over the past few years, the Army has shifted its focus in acquisition of equipment from procurement cost management to total life-cycle cost management. Specifically, the U.S. Army has targeted the operations and support portion of the total life-cycle because of its growing portion, 70-80%, of the cost to equip and maintain its forces. Many efforts, including the study of best commercial business practices, acquisition reform, and reorganization have resulted in new and revised policies to meet this goal. The effort to adopt best commercial business practices has resulted in our current organizational structure, employing a combination of hybrid and matrix structures. These structures seem to be in line with how current successful commercial businesses have structured their organizations to provide their product and or service. Where the Army's push to achieve their goal has seem to come up short is how and where they have assigned the roles and responsibilities for the key functions necessary to manage the total life-cycle cost of the equipment procured to provide the critical service to U.S. citizens; fighting and winning our nations wars.

As demonstrated by my analysis, the Army has separated the functions of acquisition and sourcing from operations and sustainment, thereby creating a misaligned organization that is unable to achieve its goals. The leading edge commercial businesses surveyed have been able to achieve their goals by organizing around the key functions necessary to achieve their goals. These structures are designed to integrate interdependent processes in order to focus on product quality and customer satisfaction. Manufacturing companies (those that produce products) have organized to best control the sourcing and procurement portion of their product's life-cycle. This type of structure places less emphasis on down-stream costs, because when a product is sold to a customer, this generally signals the end of cost management by the producer. In addition, warranties and sustainment contracts are usually bought and paid for by the customer.

The Army has modeled itself similar to the product producing companies, specifically by separating the acquisition and sourcing function from the operation and sustainment function. The problem created is the Army is not a product producing organization whose goal includes profit. It is an organization that provides a service, and should focus its efforts not only on the acquisition and sourcing of its equipment, but the operations and sustainment of its service providing equipment -- in other words, the total life-cycle cost of that equipment. As seen in the Chapter IV analysis, FEDEX, as a service related organization, which relies on the reliability and maintainability of the equipment it purchases for use in providing its service, has organized around the key functions differently. This organization is organized around the function of operations and sustainment with the acquisition function as an integral part. The product producing companies also organize around the key functions of operations and sustainment, and

acquisition and sourcing, by combining these two functions in the same department, but they do so when managing capital equipment they purchase. These companies also understand the importance of reducing total life-cycle cost of their equipment, but their profits are less susceptible to runaway O&S costs due to the small percentage this cost is in relation to their overall profits.

In dealing with the control of total life-cycle cost, particularly operation and support costs, two quotes from this study's surveys reinforce the different focus of product producing companies versus service providers in respect to operations and sustainment cost management of capital equipment:

... one of the greatest advantages of this organizational structure is in providing incentives for the reduction of downstream acquisition costs ... by organizing such that the people in the company most knowledgeable of O&S issues implement strategic procurement decisions, authority is sufficient for responsibility. That is, the goal is controlled by the people that will eventually do the work. [Ref. 21]

-- Mr. Idell, FEDEX

The responsibility of low ownership cost rests with the equipment engineer in the Facilities department at the time they purchase the equipment. We do a poor job of looking at this aspect before buying our own capital equipment. If there is a problem after installation, it is the responsibility of this engineer to get the manufacturer to fix the problem. Much of our equipment is very specialized, so we often select for it to be designed and built for function far more than maintainability with some reliability guidelines we expect to achieve. We could and should do this better. [Ref. 19]

-- Mr. Kevin R. Heise, Boeing Commercial Airplanes

Analysis of these statements supports my conclusion. Federal Express is a service related company that clearly benefits from organizing to control long-term life cycle costs. Boeing, on the other hand, is a product-oriented company -- but one which uses very

sophisticated and specialized capital equipment as part of its manufacturing processes. Clearly, costs associated with the operations and sustainment of this capital equipment is important to Boeing. Yet, Boeing seems less than satisfied with the current methods used to control these costs.

B. RECOMMENDATIONS

My analysis indicates that the Army should consider the following recommendations to better control and manage the O&S portion of life-cycle costs for the equipment it procures for its own use:

- The Army should consider changes in alignment of the key functions within organizational structure at the level of the ASA(ALT) and the PM level that place more emphasis on long term O&S costs. The current assignment of key functions within the Army does not appear to mirror that of commercial businesses used for the acquisition of capital equipment; instead it seems to mirror what commercial businesses use to minimize sourcing and procurement costs as part of product manufacture - seemingly at the expense of O&S and in the pursuit of a profit.
- The Army should continue to study commercial businesses to discover best practices in acquisition management. But instead of focusing efforts on how businesses source and procure their products, focus on how they manage acquisition and sustainment of their capital equipment, especially those businesses involved in providing services.
- Increase AMC's sustainment role in the acquisition process. As the lead logisticians within the Army, it is paramount that AMC is more heavily involved in the acquisition process to ensure the O&S portion of life-cycle costs are at the forefront.
- The Army should consider separating the "cost" portion of the "cost, performance, & schedule" mantra of all Army procurement efforts into separate procurement and O&S components. Perhaps "procurement cost, O&S cost, performance and schedule" would make a viable replacement. In addition, it should stipulate that procurement cost and O&S cost cannot be traded for schedule or performance without certain levels of approval.

C. SUGGESTED TOPICS FOR FURTHER STUDY

As in all change efforts, no solution ends the quest for better ways to do business. To continue to improve the way the Army acquires and sustains its capital equipment with life-cycle cost management at the forefront, I suggest the following topics for further study:

- Develop a new survey that uses the type function charts developed here and mass mail to companies (Manufacturing, Service, and Distribution) throughout industry. Have them identify what type of organizational structure they most represent and identify where the key functions are assigned. This will give a better representation of how commercial companies are organized to acquire and sustain their capital equipment.
- Analyze DoD's budget process (colors of money) for procurement of equipment and compare it with commercial industries' budget processes for procurement of capital equipment to highlight the impact of the budget process on procurement and present better ways of budgeting the procurement process.
- Develop a new study of life-cycle cost management, focusing only on service related companies.

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APPENDIX. EQUIPMENT LIFE-CYCLE MANAGEMENT SURVEY



HONOR TO
A TENDON OF

DEPARTMENT OF THE ARMY
STUDENT DETACHMENT, TRAINING CENTER COMMAND
FORT JACKSON, SC 29207-6400

10 September 2000

Systems Management Department,
Naval Postgraduate School

Mr. John P. Doe
Product Manager, XYZ Corporation
123 Main Street
Nashville, Tennessee 12345-0001

Dear Mr. Doe:

I am MAJ Bradley White, an active duty Army officer pursuing a Master's Degree in Systems Management focusing on Material Logistics at the Naval Postgraduate School in Monterey, California. I am writing to request your participation in a survey to gather data for my thesis. My research is targeted at identifying how successful commercial businesses manage life-cycle costs for the equipment they use to manufacture products or to provide services and what the United States Army can learn from these businesses to improve its life-cycle cost management. I am interested in obtaining commercial examples of life-cycle management and the corresponding organizational processes and structures that support them. The attached survey is designed to gather this type of information. The following paragraphs provide background of the Army's life-cycle management model.

In the Army, equipment is developed, fielded and disposed of in phases that roughly correspond to the life-cycle model in the table below.

Army Life Cycle Model (Simplified)
Research & Development
Acquisition
Operations & Support (to include manpower)
Disposal

When a product is approved for development, an Army program manager is assigned the task of managing all aspects of the item's development and procurement. Once the item is fully developed and fielded, the program manager's work is complete. Management functions for the item are then turned over to an Army logistics agency that provides logistics management support (sustainment) for the remainder of the item's useful life (normally 6 - 70 years).

The roles and responsibilities of the Army acquisition and logistics communities as they pertain to the life-cycle that I described above are undergoing a fundamental

change. The genesis of this transformation stems from a concerted effort to stress the importance of life-cycle management and the need to reduce sustainment burden and cost. Although there are differences in opinion among professionals over how great the ratio of operating and support costs are in relation to total life-cycle costs, everyone agrees that downstream acquisition costs are a considerable portion of total life-cycle costs. Various studies estimate that these ratios range from 2:1 to as high as 10:1. As a result, Congress, the DoD, and the Army have introduced a host of initiatives to optimize the acquisition and life-cycle management process. Of particular note, is the recent restructure of several organizations from as high as the Department of the Army level to as low as the Program Management Office level. In order for this transformation to be successful in reducing life-cycle costs, I think it is important that the Army looks at how successful commercial businesses manage life-cycle cost. With the information you provide in the survey, I hope to provide Army leadership with examples of how to reduce life-cycle cost for the systems and products the Army buys.

I would greatly appreciate your assistance with my survey. Completed surveys can be returned to me electronically via email at bawwhite@nps.navy.mil or in hardcopy to my mailing address at 335 Metz Road, Seaside, California 93955.

Sincerely,

Bradley A. White
Major, U.S. Army
Systems Management Department,
Naval Postgraduate School

Enclosure

Thank you for volunteering your time to complete this survey. Completed surveys can be returned to me electronically via email at bawhite@nps.navy.mil or in hardcopy to my mailing address at 335 Metz Road, Seaside, California 93955.

Sincerely,

Bradley A. White
Major, U.S. Army
Systems Management Department,
Naval Postgraduate School

1. What is the name of your company? -

2. What is your name and position title?

3. Briefly describe your company's product line.

4. Briefly describe the organizational structure of your company (e.g. departments). If possible, attaching an organizational chart would be appreciated.

5. (If your company manufactures only consumable goods, skip this question and go on to question 6.) This question will help me map your company's production methods and product life cycle management techniques to Army life cycle management methods. It asks how your organization provides life cycle support for your products.

If not, what organizational units (departments) are responsible for product development? Which ones are responsible for sustainment and customer support?

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This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

[illegible]

[illegible]

c) Once the equipment is on-hand, who is responsible for sustainment (e.g., repair parts inventories and associated budgets)? Whom do these people work for?

[illegible]

d) If your corporate headquarters purchases equipment for use in multiple geographic locations, is there a central department that manages the sustainment for the entire corporation? If so, who is it and whom do they work for? If not, who is responsible and who do they work for?

[illegible]

7. This question deals with reducing operating and sustainment costs for the items that your company procures (the equipment you buy to use in your plants). I'm interested in determining if some part of your organization is set up to drive the effort toward procuring or producing items that have low operating and sustainment costs. Are the procurement people responsible for this? Logistics people? How is the procurement process incentivized to provide quality equipment with high reliability and low sustainment cost?

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8. May I use your company's name in conjunction with the data provided in this survey in my published report? I will provide a draft copy for your review and approval prior to distribution of the final report.

9. May I contact you by email or telephone if I have further questions?

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